WPS3568

# Singapore as an Innovative City in East Asia: An Explorative Study of the Perspectives of Innovative Industries [*]

*Poh Kam WONG*

*Yuen Ping HO*

*Annette SINGH*

*Entrepreneurship Centre*

*National University of Singapore*

World Bank Policy Research Working Paper 3568, April 2005



[*] This paper was prepared for the East Asia Prospect Study being conducted in DECRG at the World Bank. The authors thank Shahid Yusuf, Anjum Altaf, and Kaoru Nabeshima for their suggestions and guidance. The authors also are grateful for the helpful comments provided by the participants of the workshop organized for this study held in Bangkok, February 22-23, 2004.

**Abstract**

The city-state of Singapore has achieved rapid economic development in the past by positioning itself as an efficient business hub in Asia. To remain competitive in the global knowledge economy, however, Singapore needs to move beyond efficiency by developing a strong "innovative" edge as well. This paper examines the challenges that Singapore faces in seeking to do so, through an explorative survey of 40 firms from three innovative sectors: high-tech manufacturing industries, knowledge-intensive business services (KIBS), and creative content industries.

Overall, while the survey confirms Singapore's continuing competitive strength in efficiency infrastructure, it also finds a favorable perception of Singapore as an innovative city. Indeed, many of the industry actors indicated that an efficient business infrastructure is a pre-requisite for their locating their innovative activities in Singapore, suggesting that the relationship between innovation and efficiency is complementary rather than substitutional.

While the study found that intellectual property (IP) and its protection are widely recognized by actors in all three sectors, interesting differences exist. In particular, intellectual property protection appears to be of greater concern to the high-tech, research-and-development-intensive manufacturing sector and the creative contents sector than to the KIBS sector. Another interesting difference is that while competition in high-tech innovation tends to be global, competition in creative content tends to have a stronger local or regional dimension.

Public policy in East Asia has traditionally emphasized the development of technological innovation capabilities in the manufacturing sector. In light of our study findings, public policy makers may need to be more sensitive to the nuanced differences in policies needed to promote the new creative content industries and the associated supporting KIBS.

## 1. Introduction

Having achieved remarkable economic growth over the last four decades (1960-2000), the city-state of Singapore entered the 21st century with a relatively high level of income/capita, but growing recognition of the need to sustain future growth through innovation. As highlighted in Wong (2004, 2003), for much of its history of rapid economic growth, Singapore had relied on a strategy of attracting direct foreign investment (DFI) from global multinational corporations (MNCs) and leveraging this to exploit technologies and know-how developed elsewhere. However, as the city-state's costs increasingly approach those of leading cities in the advanced economies, and as global competition for DFI continues to intensify particularly with the opening up of major economies in Asia like China and India with large domestic markets and abundant supply of skills, Singapore's only recourse to stay competitive is to become more innovative, i.e. not just by being efficient in "using" technologies and knowledge produced elsewhere, but by "creating" (commercializing) its own intellectual capital as well.

This paper examines the challenges and concerns that Singapore faces in becoming more innovative through the lenses of the industry players currently involved in the three leading business sectors where innovation is thought to be critical for competitive survival: high-tech manufacturing industries, knowledge-intensive business services (KIBS), and creative content industries. In particular, the paper highlights the key findings from an explorative, semi-structured survey with the senior management of 40 representative firms from these three innovative sectors.

## 2. Brief Profile of the Leading Innovative Sectors in Singapore

As widely discussed in the literature (see e.g. Yusuf and Evenett 2002, Yusuf et. al. 2003, OECD 2003, Muller and Zenker 2001, Florida 2002 and Howkins 2003), the New Economy has been identified with the following three key business sectors deemed to have a high innovative propensity: high-tech manufacturing, particularly information and communications technologies (ICT) and life sciences, knowledge-intensive business services (KIBS) and creative content industries. A brief overview of these three sectors in Singapore is provided below.

### 2.1 The high-tech manufacturing sector in Singapore

It is by now well-documented that the main source of Singapore's rapid economic growth was the leveraging of direct foreign investment by global multinational corporations (MNCs) to achieve continuous industrial re-structuring and upgrading, particularly in the high-tech manufacturing sector

(Wong 2003a). This strategy helped Singapore evolve from being a regional entrepot trade/shipping hub in Southeast Asia, to a leading Asian electronics/IT manufacturing center, continually pushing toward higher value-added products and services. Many MNCs have made Singapore their regional HQs, with some even relocating their global HQs to the city-state. Even as the economy increasingly diversified into services, it nonetheless retains a strong advanced manufacturing base; as can be seen in Table 2.1, Singapore was able to maintain the share of GDP in manufacturing over 25%, despite rising labor and land costs. By leveraging the high concentration of electronics, ICT and chemical manufacturing activities in Singapore, the Singapore government has succeeded in attracting a significant and growing base of R&D activities by the leading global MNCs in these industries (Wong, 2002a). In recent years however, concern over Singapore's heavy dependence on electronics and IT manufacturing has prompted the government to seek out alternative sources of growth; hence its attention has turned to the development of a local biotech industry.

### 2.1.1 The electronics industry

Electronics manufacturing in Singapore has been a key driver of manufacturing growth in the economy, whether measured in terms of output produced, value added, goods exported, or technology spillover to the rest of the economy. It rose to become the largest industrial cluster in Singapore during the mid-1980s, and has since continued to increase its share of total manufacturing output to 45% by the end of 2001 (Table 2.2). It also accounted for 36% percent of total manufacturing value added, or about 8% of the country's GDP, and 63% of total private-sector R & D expenditure in 2001. In addition, the electronics industry has also stimulated the development of a whole host of related supporting industries and services through backward linkages. The electronics industry has also been responsible for stimulating the development of Singapore as a major regional logistics, marketing and technical support services hub through forward linkages.

Until recently, the growth of all the electronics manufacturing industry has been driven largely by MNCs. Indeed, Singapore first emerged as an attractive offshore production location for American semiconductor MNCs in the late 1960s-early 1970s. These industries were looking for cheap labor locations overseas to perform the highly labor-intensive semiconductor assembly operations. Although Taiwan, Korea and Hong Kong were the early favorites, Singapore and Malaysia in Southeast Asia became more attractive for a variety of reasons—the increasing restriction on foreign investment in Korea, lack of English-educated workers in Taiwan, and political uncertainties over Hong Kong (and Northeast Asia in general) arising from the turmoil of the cultural revolution in China.

The government's investment promotional policies and the effective implementation of infrastructural and other support programs to accommodate the needs of industrial investors had been widely credited with helping to turn Singapore from just another labor-surplus economy into a highly attractive regional hub for offshore manufacturing production (Schein, 1996). Other conducive factors include an English-educated labor-force, a more liberal policy toward the employment of expatriate managerial and technical staff, political stability and government restraints on industrial strife. Compared to other regional economies, Singapore was not only able to attract a larger share of foreign investments, but more importantly, induce foreign MNCs to pursue higher value-added and technologically more advanced activities. Throughout the 1970s and 1980s, Singapore was able to extend her superiority in telecommunications and transportation infrastructures over other competing countries, thereby consolidating her role as the most advanced regional production hub in Southeast Asia for US, Japanese and European electronics manufacturing MNCs. With the trend toward mechanization and miniaturization in electronics, Singapore's emphasis on technical training, industrial automation and infrastructure development made manufacturing investments in the country more attractive.

Despite some temporary setbacks in the mid-1980s due to an over-ambitious technological upgrading program through a high-wage policy, Singapore quickly recovered its attractiveness for electronics industry through government interventions that resulted in lower operating and wage costs and reduced rigidities in the labor market. In the second half of the 1980s, the rapid growth of the computer and related industries helped spur another wave of new investment in Singapore, in particular in the manufacturing and assembly of disk drives, personal computers, computer monitors and printers (Wong, 2002).

By the early 1990s, although Singapore had become increasingly un-competitive in the more labor-intensive stages of electronics production, three developments helped make Singapore attractive for continuing investment in electronics manufacturing. First, the increasing shift toward "time-base" competition in electronics products means that global supply chain management capability becomes increasingly critical, thus Singapore's superior logistics infrastructure becomes an important advantage. Increasingly, electronics MNCs use Singapore as their regional logistics hub, integrating the flow of parts, components and finished products from throughout Southeast Asia via Singapore. Secondly, as part of this shift toward globalization of production, there is an increasing trend toward outsourcing of production by many electronics OEMs to specialized, dedicated contract manufacturers (Wong, 2000). Singapore quickly became a major hub for some of the leading contract manufacturers in the world, including a number of home-grown firms, due to a combination of superior transport and communications infrastructure and a critical mass of supporting industries providing various manufacturing services. Thirdly, as the government intensified investment in public R&D and the supply of technically-competent

R&D manpower since the early 1990s, an increasing number of electronics MNCs have found Singapore an attractive location for product and process R&D activities. Some MNCs like HP, Philips and Motorola have given Singapore "world product mandate" in selected product lines that cover responsibility from design to marketing and technical support. As evident in Table 2.4, private sector R&D in the electronics and IT industry had increased sharply in recent years, rising from less than S$200 million in 1990 to S$1.3 billion in 2001.

### 2.1.2 The biotech industry

The efforts to create a biotech industry in Singapore have in some ways replicated the development of the electronics manufacturing industry, being strongly driven by the government, with a high degree of leveraging of foreign investment and foreign talent.

The Singapore government's biotechnology initiatives began in the 1980s, but it is only in the last three to four years that its efforts have gained momentum, following its decision to make the biomedical industry the fourth pillar of the economy (Arnold, 2003). Its vision is to turn Singapore into Asia's premier hub for biomedical sciences, with world-class capabilities across the entire value chain, from basic research to clinical trials, product/process development, full-scale manufacturing and healthcare delivery (Biomed-Singapore, 2003). With a new US$1 billion fund to boost public investment in several new life science research institutes, to co-fund new R&D projects by global pharmaceutical firms, as well as to initiate the building of a new life science park (Biopolis), major growth in R&D in life science is expected over the next few years, with the aim of helping Singapore to diversify away from its current high dependence on electronics/IT.

Until recently, the biomedical industry in Singapore has been dominated by large, foreign-owned pharmaceutical companies, with dedicated biotech firms (DBFs) still in an embryonic stage of development. Firms like GlaxoSmithKline (GSK), Schering-Plough, and Merck first came to Singapore to take advantage of the country's well-established competency in manufacturing. The majority of these firms are headquartered in the United States, and they manufacture pharmaceutical D active or intermediate products in bulk. Companies such as Genencor, AstraZeneca, and Bristol Myers Squibb (BMS) also established regional headquarters in Singapore because it is a major Asian business hub (Finegold et. al. 2004).

As can be seen in Table 2.3, Singapore's pharmaceutical manufacturing output was relatively low until the mid-1990s, but has grown very rapidly at an average compound growth rate of 24% from S$1.4 billion in 1995 to S$5.1 billion in 2001, primarily for export. In terms of Value Added, the increase was from S$1 billion to S$2.8 billion. Production was concentrated in a few large firms: As of 2002, there

were only 38 companies classified in the pharmaceuticals sector, producing some S$215 million of output per establishment. This was significantly higher than the average of $35.7 million of output per establishment for all manufacturing sectors (Finegold et.al, 2004).

To accelerate the pace of development of Singapore into a major biomedical science hub, the government initiated two major investment thrusts. Firstly, through the Agency for Science, Technology and Research (A*STAR), the government put in place policies, resources, and a research and education architecture intended to build indigenous biomedical science R&D competencies. More than $500 million has already been invested in new research centers, with another S$1 billion in funding committed through 2006.

Secondly, the government entrusted the Economic Development Board (EDB) to expand its role from not only attracting large foreign pharmaceutical MNCs to invest manufacturing facilities in Singapore, but also to promote investment in early stage dedicated biotechnology firms (DBFs) that were willing to bring key new technologies and generate higher value-added research jobs in Singapore. With no history of home-grown, high-tech companies, Singapore has not developed a community of venture capitalists or other private investors who are knowledgeable about and interested in investing in biomedical start-ups. Those investors interested in this sector have tended to put their resources into U.S. firms with more proven track records and lower perceived risk. To fill this investment gap, EDB has committed an additional S$2 billion to the bioscience area. Half the amount is invested in three bioscience funds which invest in local start-ups and Singapore-based joint ventures, and provide financial incentives to attract MNCs to Singapore. Another S$1 billion is set aside to attract three to five world-class corporate centers of research (EDB, 1999; Saywell, 2001).

EDB has also stepped up efforts to attract foreign pharmaceutical companies to set up R&D or clinical research operations in Singapore. Some prominent early examples of these partnerships with MNCs include S*Bio, Merlion, and Lilly Systems Biology. S*Bio was established as a joint venture between Chiron and the EDB using Chiron's technology platform to develop products for cancer and infectious diseases, especially those in Asia. Merlion originated as a joint venture between Glaxo and the EDB to perform more traditional drug-discovery and screening natural samples from across Asia for possible drug targets. After the merger that formed GSK, this unit was spun off and was privatized as a stand-alone business, with Merlion obtaining all of GSK's vast library of natural compounds along with its Asian samples. Today, Merlion owns one of the world's best private collections of natural samples with close to half a million extracts that they are screening for potential drugs, and has grown through collaborations with international drug companies, including Merck, British Biotech and NovImmume. Lilly Systems Biology (LSB) is a wholly owned subsidiary of Lilly that was launched in Singapore in 2002 with generous, multi-year financial incentives from EDB. LSB's mission is to integrate various

biological data and approach the problem of studying complex diseases from a more encompassing perspective of a cell and its system. Through intensive use of computational biology, LSB hopes to discover new drug targets and biomarkers, and better understand mechanisms of action within the cell.

In addition to drug-discovery firms, Singapore has also begun to market itself as a regional clinical trials center. The country is exploiting several advantages including a good healthcare system, a multi-racial population for studying drug effects, and an ideal location for drug trials on Asian diseases. They have had some early success attracting companies like Pharmacia, Novo Nordisk and some of the large contract research organizations (CROs) to establish clinical trial centers in Singapore. Johns Hopkins University and the National University Hospital (Singapore) set up an International Medical Center to provide patient care and to conduct clinical trials in oncology. This center also offers clinical education programs and degrees in conjunction with the National University of Singapore. Despite these early successes, there are still relatively few clinical trials taking place in Singapore. This may be due to the strong and growing competition for the Asian clinical research market from Taiwan, Australia and Japan, which have the advantage of larger domestic markets and the fact that pharmaceutical companies may be reluctant to use these clinical trial centers due to an unproven track record.

While the above progress suggests some degree of success in replicating the strategy of leveraging MNCs in the biotechnology sector, limitations of this strategy have become evident. S*Bio for example, has grown rapidly in terms of manpower, but without any distinctive IP, it is nearly impossible to create a competitive advantage for itself. In addition, it has struggled to recruit the experienced managerial talent needed to provide strategic direction, with a lack of local candidates and difficulty attracting top people from abroad. Thus far, it has not been able to compensate for the lack of internal talent by forming partnerships with other Singapore companies or research institutes. S*Bio's early struggles, along with the difficulty EDB has had in convincing other DBFs to locate in Singapore, suggest the strategy of relying on MNCs to catalyze the growth of a research-driven biotechnology industry may prove difficult to execute. SurroMed, a US-based firm specializing in molecular bar-coding technology, for instance, opened a US$25 million R&D center in 2001 with direct investment from EDB. A lot of publicity accompanied this investment, but two years later, Surromed's Singapore subsidiary has been disbanded, and the scientists were incorporated into the Institute of Bioengineering while the technology was returned to the parent company.

Alongside these MNCs, a small set of start-up companies have emerged in Singapore's biotech cluster. These start-up firms bear a much closer resemblance to early stage counterparts in the U.S. or U.K. than they do to the better-resourced, government-backed ventures like S*Bio and Merlion. They have typically been based on IP from a university or the inspiration of an entrepreneur and are trying to fill the void between the basic research of the university labs and the more mature commercial

technologies that VCs, EDB, or foreign pharmaceutical firms are willing to fund. With limited access to these funding sources, they have struggled to grow and had to develop business models that generate revenue quickly. These firms have chosen to locate in Singapore not because of generous investment incentives from the government, but rather because of where the founders were based and the more general business advantages of Singapore – location, strong infrastructure, and good quality of life for professionals. However, they also struggle with finding appropriate manpower, given a risk-averse environment where people tend to prefer stable jobs working for MNCs or the government than in high-risk startups.

While only a handful of DBFs in drug discovery and biomedical devices had emerged in Singapore so far in recent years, the progress was more promising in the area of stem cells and bioinformatics. A combination of US government policy against new stem cell lines for research, plus stem cell research capabilities at a local university, gave Singapore a window of opportunity to quickly attract a critical mass of stem cell-based activities, while the strong synergy with IT skills enabled Singapore's early entry into bioinformatics.

In summary, while the Singapore government appears to have made big investment bets in biotechnology research infrastructures in recent years, it remains too early to judge whether the sector will flourish. Singapore's past strategy in biomedical industry development stands in strong contrast to that of India, which has historically developed a strong base of indigenous pharmaceutical manufacturing firms making generic drugs, and which are now using their financial resources to deepen their competencies into biomedical R&D, including acquisition of Western biotech firms. Arguably, Singapore could not have pursued a strategy similar to India, which has a large domestic market, for which it could justifiably seek waivers from enforcement of pharmaceutical product patents protection to support the development of generics at low price due to the low-income level of its population. Without strong local pharmaceutical firms that have the financial resources to fund biotech R&D that has a long gestation period, Singapore has no choice but to rely on public funding to grow new de novo biotech firms.

#### 2.1.3 Recent Shift toward "Re-making" Singapore into an Innovation-driven, Entrepreneurial Economy

As reflected by the development of a strong, internationally competitive electronics sector and a rapidly growing pharmaceutical manufacturing cluster, Singapore's unique economic development model combining an open-economy framework with a strong state involvement in leveraging MNCs to pursue targeted industrial policy objectives has indeed produced remarkable success in the past. However, by the late 1990s, there were growing concerns among the city-state's political leaders that this

model needed to be changed as the economy has to compete "close to the frontier" of the global knowledge economy, as opposed to the earlier, easier task of technological catch up. It is not only the case that it is harder now for Singapore to compete for global MNC investment due to its high cost structure and the growing reluctance of the world's technological leaders to shift their core innovation assets to Singapore. More significantly, new economic growth and innovations in the global marketplace are increasingly coming from young, dynamic firms clustering in a small number of high-tech "hotspots" in the world that provide the critical mass of advanced knowledge sources (universities, advanced public and corporate research labs), venture capital, entrepreneurial talents, knowledge workers, specialized professional services, sophisticated end-users and enabling institutions like intellectual property protection, public exit markets, etc. Although long dominated by the Silicon Valley, new competing high-tech regions have emerged around the world, including Israel in the Middle East, Ireland in Europe, Shanghai and Beijing in China, Seoul in Korea, and Bangalore in India (Rosenberg, 2002). There is thus a perceived danger that the traditional policy incentives for attracting and supporting large global, MNCs not only may not work for attracting young, entrepreneurial firms, but that this very strategy of relying on large established MNCs for job creation and technology transfer may stifle the development of indigenous entrepreneurship and technological innovation. The earlier discussion on biotech industry suggests that there might be some basis to this concern.

Concern for policy change in Singapore escalated in the light of the relatively weaker performance of the Singapore economy over the last 3-4 years, in the wake of the 1997 Asian financial crisis and the global economic slowdown exacerbated by Sept. 11 and the recent Asian SARS scare. Indeed, a high-level committee, the Economic Review Committee (ERC) was formed in 2002 to study how to "fundamentally re-make" the Singapore economy to better compete in the global knowledge economy, where the combination of advanced knowledge, technological innovation, artistic creativity and entrepreneurial dynamism are becoming the decisive sources of competitive advantage (ERC, 2002).

As part the ERC Report, the report of the Subcommittee on Entrepreneurship and Internationalization (released in Sept 2002) in particular recommended many policy changes to re-make Singapore into a competitive knowledge-based, entrepreneurially-driven economy. Specifically, it identified 6 broad areas of policy emphasis to make the Singapore economy more conducive for entrepreneurial development: (a) Culture: to influence the cultural values of Singaporean toward entrepreneurship by providing students and working professionals more opportunities to learn about entrepreneurship; (b) Capability building: to attract more entrepreneurial talents from overseas and encouraging greater mobility of talents between public and private sector; (c) Conditions: to reduce government regulatory red-tape and reviewing the role of GLCs in the domestic economy; (d) Connectivity: to enhance the global connectivity of Singapore to the world; (e) Capital: to improve start-

up and SME access to capital; and finally (f) Catalyst role of government: to extend investment and tax incentives currently available to large MNCs to smaller enterprises as well (ERC, 2002). Although some of the recommended policy shifts had in fact been initiated prior to the report, they have been given greater impetus after the release of the report.

In addition to increasing emphasis on promoting local high-tech start-ups and entrepreneurship in general, the ERC Report has also highlighted the growing importance of Knowledge-Intensive Business Services (KIBS) and Creative Contents Industries in re-making Singapore into a truly innovative global city.

### *2.2 Knowledge-Intensive Business Services (KIBS) Sector*

Besides high-tech manufacturing, knowledge-intensive business services (KIBS) have been recognized by the Singapore government as a critical component of a knowledge-based economy (KBE). While efficient business services has long been recognized by the government as important for Singapore's role as a regional trading hub, it is only in more recent years that the KIBS have been singled out for their importance with regards to innovation. KIBS are important for innovation not only because they provide critical support services to innovation activities in the high-tech sectors of the economy, but also because KIBS industries to facilitate diffusion of innovation, and moreover are themselves major generators of innovation (Wong and He, 2004).

While the scope of what constitutes KIBS remains somewhat arbitrary, we can get an idea of its relative importance in the Singapore economy by examining the economic contribution of the following key KIBS sub-sectors: legal services, management consulting, IT services, consultant engineering and architecture industries. Amongst these industries, IT services and management consulting are the largest, contributing about one-third each to the sector's value added in 2001. Overall, these KIBS sub-sectors employed over 71,000 people in 8,771 establishments in 2001, and generated $5.1 billion value added in 2001, representing 43.1% of total business services industry value added (see Table 2.6) or 3.5% of total GDP. Unlike the high-tech manufacturing sector, where several hundred large, foreign firms contributed the bulk of output, the KIBS sector is characterized by many small firms. The average employment size is less than 10 people and the average value added is only $0.58 million. While many large foreign subsidiaries or affiliates of global KIBS firms have operational presence in Singapore, the majority of KIBS firms are locally owned.

**Table 2.1 Singapore's GDP Distribution by Sectors, 1960-2002 (%)**

| Industry | 1960 | 1970 | 1980 | 1990 | 1995 | 2000 | 2002 |
|---|---|---|---|---|---|---|---|
| Agriculture & Mining | 3.9 | 2.7 | 1.5 | 0.4 | 0.2 | 0.1 | 0.1 |
| Manufacturing | 11.7 | 20.2 | 28.1 | 28.0 | 26.3 | 25.9 | 27.4 |
| Utilities | 2.4 | 2.6 | 2.1 | 1.9 | 1.6 | 1.7 | 1.8 |
| Construction | 3.5 | 6.8 | 6.2 | 5.4 | 7.0 | 6.0 | 5.6 |
| Commerce | 33.0 | 27.4 | 20.9 | 16.3 | 17.3 | 19.1 | 15.5 |
| Transport & Communication | 13.6 | 10.7 | 13.5 | 12.5 | 12.4 | 11.1 | 11.9 |
| Financial & Business Services | 14.4 | 16.7 | 18.9 | 25.5 | 25.5 | 25.3 | 25.3 |
| Other Services | 17.6 | 12.9 | 8.7 | 9.9 | 9.8 | 10.9 | 12.4 |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Notes*: 1. Figures may not add up to 100 due to rounding.
2. Total GDP excludes owner-occupied dwellings and calculations for taxes and duties on imports and imputed bank service charge.

*Sources*: Calculated from MTI (1990); Department of Statistics, *Yearbook of Statistics Singapore*, various years; Ministry of Trade and Industry, *Economic Survey of Singapore*, various years.

**Table 2.2 Electronics Manufacturing Industry Growth in Singapore, 1960-2001**

| Year | Output $mn | No. Workers | Value Added $mn | Fixed Asset $mn | Val.Add/ Labor $'000 | Val.Add/ Output % | Capital/ Labor $'000 |
|---|---|---|---|---|---|---|---|
| 1960 | 17.1 | 1,252 | 7.9 | na | 6.3 | 46.2 | na |
| 1970 | 212.9 | 11,251 | 99.1 | na | 8.8 | 46.5 | na |
| 1980 | 5,344.0 | 71,727 | 1,668.9 | 585.1 | 23.3 | 31.2 | 8.2 |
| 1990 | 27,878.1 | 122,797 | 7,716.6 | 3,757.3 | 62.8 | 27.7 | 30.6 |
| 2001 | 62,201.5 | 98,012 | 11,615.3 | 15,911.0 | 118.5 | 18.7 | 162.3 |
| | | | Average Per Annum Growth Rate (%) | | | | |
| 1960-1970 | 32.4 | 26.9 | 32.1 | | 3.4 | | n.a. |
| 1970-1980 | 34.2 | 18.1 | 29.3 | | 10.2 | | n.a. |
| 1980-1990 | 18.0 | 5.5 | 16.5 | | 10.4 | | 14.1 |
| 1990-2001 | 7.6 | -2.0 | 3.8 | | 5.9 | | 16.4 |
| | | | Percentage of Total Manufacturing | | | | |
| 1960 | 3.7 | 4.6 | 5.6 | na | | | |
| 1970 | 5.5 | 9.3 | 9.1 | na | | | |
| 1980 | 16.9 | 25.1 | 19.6 | 7.8 | | | |
| 1990 | 39.1 | 34.9 | 35.7 | 20.8 | | | |
| 2001 | 45.0 | 28.4 | 36.4 | 33.1 | | | |

*Sources*: Economic Development Board, Report on the Census for Industrial Production, various years; Economic Development Board, Report on the Census of Manufacturing Activities 2000.

**Table 2.3 Pharmaceutical Products Manufacturing Growth in Singapore, 1960-2001**

| Year | Output $mn | No. Workers | Value Added $mn | Fixed Asset $mn | Val.Add/ Labor $'000 | Val.Add/ Output % | Capital/ Labor $'000 |
|---|---|---|---|---|---|---|---|
| 1990 | 1,020.8 | 1,664 | 809.1 | na | 486.2 | 79.3 | na |
| 1995 | 1,339.0 | 1,855 | 1,083.5 | 583.7 | 584.1 | 80.9 | 314.66 |
| 2000 | 4,839.1 | 1,928 | 2,998.4 | 858.6 | 1,555.2 | 62.0 | 445.31 |
| 2001 | 5,134.2 | 2,375 | 2,796.8 | 2,085.3 | 1,177.6 | 54.5 | 878.01 |
| | | | Average Per Annum Growth Rate (%) | | | | |
| 1990-2001 | 15.8 | 3.3 | 11.9 | 23.6[1] | 8.4 | | 18.7[1] |
| | | | Percentage of Total Manufacturing | | | | |
| 1990 | 1.4 | 0.5 | 3.7 | na | | | |
| 2001 | 3.7 | 0.7 | 8.8 | 4.3 | | | |

[1] Calculated for 1995-2001

*Note*: Data for 1990 is from SSIC 35220 (Medicinal & pharmaceutical products), and from SSIC 242 (Pharmaceutical products) for all other years

*Sources*: Economic Development Board, Report on the Census for Industrial Production, various years; Economic Development Board, Report on the Census of Manufacturing Activities, various years

**Table 2.4 Growth Trend of Private Sector R&D Expenditure in Singapore, 1981-99**

| Year | Total Private Sector R&D Expenditure (S$mn) | Private R&D Expenditure in Electronics & IT Industries[1] (S$mn) | % | Private Sector R&D Expenditure in Life Sciences (S$mn) | % |
|---|---|---|---|---|---|
| 1981 | 44.2 | 27.5 | 62.2 | na | na |
| 1984 | 106.7 | 53.4 | 50.0 | na | na |
| 1987 | 225.6 | 147.1 | 65.2 | na | na |
| 1990 | 309.5 | 177.6 | 57.4 | na | na |
| 1991 | 442.0 | 273.9 | 62.0 | na | na |
| 1992 | 577.5 | 324.2 | 56.1 | na | na |
| 1993 | 618.9 | 338.1 | 54.6 | 24.8 | 4.0 |
| 1994 | 736.2 | 385.2 | 52.3 | 38.6 | 5.2 |
| 1995 | 881.4 | 475.3 | 53.9 | 34.4 | 3.9 |
| 1996 | 1133.4 | 706.9 | 62.4 | 37.9 | 3.3 |
| 1997 | 1314.5 | 760.3 | 57.8 | 58.3 | 4.4 |
| 1998 | 1536.1 | 882.6 | 57.5 | 63.8 | 4.2 |
| 1999 | 1670.9 | 933.0 | 55.8 | 89.7 | 5.4 |
| 2000 | 1866.0 | 1182.8 | 63.4 | 83.5 | 4.5 |
| 2001 | 2045.0 | 1292.2 | 63.2 | 113.6 | 5.6 |

[1]Figures from 1993 onwards exclude electrical products but include IT and Communications.

*Source*: *National Survey of R&D in Singapore* (various years), Agency for Science, Technology and Research.

**Table 2.5 Comparison of high-tech manufacturing and total manufacturing sectors, 1990-2001**

| | Year | Output $mn | No. of workers | Value added $mn | Fixed Assets $mn | Value added/ worker $'000 |
|---|---|---|---|---|---|---|
| Electronics manufacturing (a) | 1990 | 27,878.1 | 122,797 | 7,716.6 | 3,757.3 | 62.8 |
| Pharmaceutical products manufacturing (b) | 1990 | 1,020.8 | 1,664 | 809.1 | na | 486.2 |
| High-tech manufacturing (a+b) | 1990 | 28,899.0 | 124,461 | 8,525.7 | na | 68.5 |
| Total manufacturing (c) | 1990 | 71,333.2 | 351,674 | 21,606.8 | 18,030.6 | 61.4 |
| | | | *Percentage* | | | |
| Electronics manufacturing | 1990 | 39.1 | 34.9 | 35.7 | 20.8 | |
| Pharmaceuticals manufacturing | 1990 | 1.4 | 0.5 | 3.7 | na | |
| (a+b) | 1990 | 40.5 | 35.4 | 39.5 | na | |
| Electronics manufacturing (a) | 2001 | 62,201.5 | 98,012 | 11,615.3 | 15,911.0 | 118.5 |
| Pharmaceutical products manufacturing (b) | 2001 | 5,134.2 | 2,375 | 2,796.8 | 2,085.3 | 1,177.6 |
| High-tech manufacturing (a+b) | 2001 | 67,335.7 | 100,387 | 14,412.0 | 17,996.2 | 143.6 |
| Total manufacturing (c) | 2001 | 138,323.0 | 345,141 | 31,922.8 | 48,129.6 | 92.5 |
| | | | *Percentage* | | | |
| Electronics manufacturing | 2001 | 45.0 | 28.4 | 36.4 | 33.1 | |
| Pharmaceuticals manufacturing | 2001 | 3.7 | 0.7 | 8.8 | 4.3 | |
| (a+b) | 2001 | 48.7 | 29.1 | 45.1 | 37.4 | |

*Note*: The high-tech manufacturing sector comprises SSIC35220 medicinal & pharmaceutical products and SSIC 384 electronics for 1990. Comprises SSIC 242 pharmaceutical products and SSIC31 electronics for 2001

*Sources*:

Economic Development Board (EDB). (1990). *Report on the Census of Industrial Production 1990*. Singapore: EDB

Economic Development Board (EDB). (2001). *Report on the Census of Manufacturing Activities 2001*. Singapore: EDB

As is true in other advanced countries, the KIBS sector in Singapore has experienced relatively faster growth than the overall economy in recent years. Over 1990-2001, KIBS value added and operating receipts grew at about 15% per year, more than twice the overall economic growth rate. Moreover, unlike high manufacturing, where rapid value added growth had been accompanied by a net reduction of employment due to increasing capital intensity, the KIBS sector has been a steady source of employment growth for the economy over the last decade. Between 1990 and 2001, the number of workers employed in the KIBS sector grew at an annual average rate of 10.8%. This growth has been accompanied by a moderate increase in labor productivity, with value added per worker growing at 3.5% per annum, to reach $71,300 in 2001. Although lower than the labor productivity level of high-tech manufacturing due to its much lower capital intensity, the KIBS sector had a higher share of workers with tertiary education, and actually exhibited a higher intensity of investment in innovation activities than the manufacturing sector as a whole (Wong and He, 2004). Moreover, as pointed out earlier, KIBS had an economic significance beyond its own direct employment and value add contribution, due to its significant multiplier linkages with other key sectors of the economy, particularly high-tech manufacturing.

It is interesting to note that, while all KIBS sub-sectors have expanded, it is the IT services sub-sector that has achieved the fastest growth, increasing its share of total KIBS from 21% in 1990 to 35% in 2001. As chronicled by Wong(1998), the Singapore government has strategically targeted IT for promotion since the early 1980s, and has put in place a comprehensive policy framework and implementation mechanism that cover both the development of IT services industries as well as the diffusion of IT usage. In contrast, the other KIBS sub-sectors have not been accorded the same level of strategic priority. The greater ease with which IT services could be exported to the region versus other sub-sectors like legal services, which face greater entry barriers and need for localization, also explains the slower export growth of the other sub-sectors.

**Table 2.6 KIBS sector growth in Singapore, 1990-2001**

| | Establishments | Employment | Operating Receipts ($million) | Value Added ($million) | Value added/ Labor ($'000) | Value added/Firm ($'000) |
|---|---|---|---|---|---|---|
| 1990 | 2,522 | 23,042 | 2,051.9 | 1,130.9 | 49.1 | 448.4 |
| 1995 | 5,005 | 45,023 | 6,293.9 | 3,037.3 | 67.5 | 606.9 |
| 1996 | 5,437 | 46,054 | 6,342.0 | 3,279.6 | 71.2 | 603.2 |
| 1997 | 6,396 | 50,195 | 7,414.9 | 3,780.4 | 75.3 | 591.1 |
| 1998 | 6,767 | 57,808 | 8,157.3 | 3,897.1 | 67.4 | 575.9 |
| 1999 | 6,807 | 62,677 | 9,223.3 | 4,451.5 | 71.0 | 654.0 |
| 2000 | 6,789 | 65,766 | 10,416.4 | 4,935.9 | 75.1 | 727.0 |
| 2001 | 8,771 | 71,199 | 10,918.0 | 5,077.9 | 71.3 | 578.9 |
| | | | Compound average annual growth rate (%) | | | |
| 1990-2001 | 12.0 | 10.8 | 16.4 | 14.6 | 3.5 | 2.4 |

*Note*: KIBS data includes the following industries: IT and related services, legal activities, market research, business & management consultancy activities, engineering services, architectural, quantity surveying, building & appraisal services.

*Sources*:

Singapore Department of Statistics (DOS). (various years). *Economic Surveys Series: Business Services and Real Estate*. Singapore: DOS.
Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: Architectural, Engineering & Technical Services.* Singapore: DOS.
Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: IT & Related Services.* Singapore: DOS.
Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: Professional Services.* Singapore: DOS.

**Table 2.7 Sectoral composition of KIBS sector in Singapore, 1990-2001**

| | Establishments | Employment | Operating receipts ($million) | Value added ($million) | Value added/ Worker ($'000) |
|---|---|---|---|---|---|
| **1990** | | | | | |
| IT and related services | 338 | 5,524 | 581.4 | 240.8 | 43.6 |
| Legal Activities | 446 | 4,884 | 362.9 | 269 | 55.1 |
| Market Research, Business & Management Consultancy Activities | 1,032 | 6,512 | 631.7 | 357.3 | 54.9 |
| Engineering services | 339 | 3,477 | 274.2 | 144 | 41.4 |
| Architectural, quantity surveying, building & appraisal services | 367 | 2,645 | 201.7 | 119.8 | 45.3 |
| *Total KIBS sector* | *2522* | *23,042* | *2051.9* | *1130.9* | *49.1* |
| | | Percentage (%) | | | |
| IT and related services | 13.4 | 24.0 | 28.3 | 21.3 | |
| Legal Activities | 17.7 | 21.2 | 17.7 | 23.8 | |
| Market Research, Business & Management Consultancy Activities | 40.9 | 28.3 | 30.8 | 31.6 | |
| Engineering services | 13.4 | 15.1 | 13.4 | 12.7 | |
| Architectural, quantity surveying, building & appraisal services | 14.6 | 11.5 | 9.8 | 10.6 | |
| *Total KIBS sector* | *100.0* | *100.0* | *100.0* | *100.0* | |
| **2001** | | | | | |
| IT and related services | 2716 | 24,296 | 4,802.6 | 1,771.4 | 72.9 |
| Legal Activities | 741 | 8,486 | 988.1 | 736.4 | 86.8 |
| Market Research, Business & Management Consultancy Activities | 3,779 | 22,069 | 2,923.2 | 1,524.8 | 69.1 |
| Engineering services | 903 | 9,142 | 1,548.2 | 615.9 | 67.4 |
| Architectural, quantity surveying, building & appraisal services | 632 | 7,206 | 655.8 | 429.4 | 59.6 |
| *Total KIBS sector* | *8,771* | *71,199* | *10,918.0* | *5,077.9* | *71.3* |
| | | Percentage (%) | | | |
| IT and related services | 30.97 | 34.12 | 44.0 | 34.9 | |
| Legal Activities | 8.45 | 11.92 | 9.1 | 14.5 | |
| Market Research, Business & Management Consultancy Activities | 43.09 | 31.00 | 26.8 | 30.0 | |
| Engineering services | 10.30 | 12.84 | 14.2 | 12.1 | |
| Architectural, quantity surveying, building & appraisal services | 7.21 | 10.12 | 6.0 | 8.5 | |
| *Total KIBS sector* | *100.0* | *100.0* | *100.0* | *100.0* | |

*Note*: KIBS data includes the following industries: IT and related services, legal activities, market research, business & management consultancy activities, engineering services, architectural, quantity surveying, building & appraisal services.

Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: Architectural, Engineering & Technical Services.* Singapore: DOS.

Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: IT & Related Services.* Singapore: DOS.

Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: Professional Services.* Singapore: DOS.

## 2.3 Creative Content Sector

Creative contents industry represents the latest strategic industry focus in the government's attempt to re-make Singapore into an innovative city.

As yet there is no standard way of defining the creative content sector, hence estimates of its size and growth may vary according to the scope of industries included. The ERC report, using a somewhat broad definition, estimated the creative cluster to have a value of almost S$5 billion in 2000, contributing to about 3% of GDP. Another estimate of the contribution of the creative content sector is available from Toh et al (2003). Using a slightly narrower definition than used by the ERC report (covering mainly IT services, advertising, interior graphics and fashion design, architectural services, arts/antiques trade, crafts, photography, and industrial design), they found the creative industries to have a value added of $2.98 billion in 2000, contributing to about 1.9% of GDP. They also estimated the employment in the creative industries in 2000 to be 46,850, with labor productivity to be $63,500 per worker.

Both the ERC Report and Toh et al (2003) included under creative contents industry a number of sub-sectors that have already been covered under the KIBS sector (IT services, architectural services, etc.). To avoid too much overlap with the KIBS sectors, for the purposes of our study, we took a narrower definition of the creative content sector to encompass only the software development, publishing, music, film, broadcasting and dramatic arts industries. Based on this narrower scope, we estimated the sector to have generated a total value added of $1.6 billion and employment of about 26,500 in 2001, making it the smallest of the three innovative sectors within our study (see Table 2.8).

Despite its relatively small size, the creative content sector has grown moderately fast over the last 15 years. Value added grew at an average of 7.4% per annum between 1986 and 2001, while operating receipts grew by about 10%. However, employment has grown more slowly, at 3.9% p.a. from 1986 to 2001. Compared to the high-tech manufacturing sector and the KIBS sector, labor productivity within the creative contents sector has grown the slowest, at 3.4% per annum, from $37,300 in 1986 to $61,200 in 2001.

Like the knowledge-intensive business services, the creative content sector is populated with mainly small companies. Indeed, the growth of the industry over the years has been accompanied by the entry of many small-sized firms, resulting in the average firm size falling from about 20 people per firm in 1986 to about ten people in 2001. Similarly, value added per firm fell from $0.73 million in 1986 to $0.62 million in 2001.

The composition of the creative contents sector changed significantly over the period 1986-2001. Reflecting Singapore government's high policy emphasis on promoting ICT development, the software development industry experienced the fastest growth over the years to become the sector's largest industry, accounting for about 70% of the creative content sector's total value added, and over

half of its employment in 2001. This stands in stark contrast to its shares in 1986, when it contributed only 1-2% of the sector's value added and employment. As explained earlier, the high growth of the software development industry has been strongly influenced by public policy, with export a major driver for growth in the 1990s (Wong 1998). While business application software was the major focus of earlier software development activities, in recent years there is a shift toward multimedia content development, including games and educational content.

While not growing as fast as software development, the other sub-sectors of the creative contents sector – broadcasting, movie/video/music production/distribution and the performing arts also grew rapidly over 1986-2001. Publishing activities seemingly registered a decline in economic output, but this is due to a change in the definition of publishing activities after 1990 to exclude printing activities. The performing arts remained the smallest sub-sector in 2001, accounting for less than 1.5% of total creative content value added, although it is likely to have expanded much more rapidly over the last 2 years with the opening of a brand new performing arts hall (the Esplanade) in 2003.

As highlighted by Toh et. al.(2003), the knowledge, products and services produced by the creative industries also serve as inputs into other sectors in the economy. As such they are an important source of competitive advantage, especially as goods and services become increasingly knowledge- and technology- intensive. Using their broader definition of creative contents, Toh et al found that there is substantial usage of creative inputs by Singapore's major industries, especially in services. Overall, 6.1% of inputs for services comes from local creative industries. Dependence on the creative industries for inputs is particularly strong in education (9.7%) because of its heavy usage on publishing and IT services, as well as in business services and communications (6.9%), and wholesale & retail trade (6.42%).

When benchmarking Singapore's creative contents industries against those of other advanced countries, it becomes clear that there is substantial scope for development in the local creative content sector. Not only is the value added contribution of creative content sector in total GDP smaller for Singapore than is found in countries like USA, UK and Canada, the level of labor productivity in Singapore's creative content industries are also lower than is found in these countries.

**Table 2.8 Creative content sector growth in Singapore, 1986-2001 [1]**

| | Establishments | Employment | Operating Receipts ($million) | Value Added ($million) | Value added/ Labor ($'000) | Value added/Firm ($'000) |
|---|---|---|---|---|---|---|
| 1986 | 718 | 14092 | 1240.9 [2] | 526.1 | 37.3 | 732.7 |
| 1990 | 958 | 22856 | 2475.9 [4] | 1000.4 | 43.8 | 1044.2 |
| 2001 | 2573 | 26488 | 5399.4 | 1590.2 | 60.0 | 618.0 |
| | | | Compound average annual growth rate (%) | | | |
| 1986-2001 | 8.8 | 3.9 | 9.4 [6] | 7.4 | 3.4 | -1.4 |

[1] Excludes broadcasting.
[2] If operating receipts from Singapore Broadcasting Corporation are included (1985 figure) then sector operating receipts becomes $1,356.7 million
[3] If remuneration from Singapore Broadcasting Corporation is included (1985 figure) then sector remuneration becomes $387.9 million
[4] If operating receipts from Singapore Broadcasting Corporation is included (FY1990 figure) then sector operating receipts becomes $2,671.9 million
[5] If remuneration from Singapore Broadcasting Corporation is included (FY1990 figure) then sector remuneration becomes $681.8 million
[6] If operating receipts from Singapore Broadcasting Corporation are included (1985 figure) then sector growth rate becomes 9.7%
[7] If operating receipts from Singapore Broadcasting Corporation are included (1985 figure) then sector growth rate becomes 9.4%

*Note*: The creative content sector includes the following industries: IT development; publishing; motion picture production, distribution & allied services; radio & television services, theatrical producers, entertainment. IT development has been included in both the KIBS sector and the creative content sector
*Sources*:
Singapore Department of Statistics (DOS). (Various years). *Economic Surveys Series: Business Services and Real Estate*. Singapore: DOS.
Singapore Department of Statistics (DOS). (Various years) *Economic Surveys Series: Community, Social & Personal Services.* Singapore: DOS.
Data obtained from DOS

**Table 2.9a Sectoral composition of creative content sector in Singapore, 1986-2001**

| | Establishments | Employment | Operating Receipts | Value Added | Value Added/ worker |
|---|---|---|---|---|---|
| **1986** | | | S$million | S$million | S$'000 |
| IT Development | 44 | 265 | 29.4 | 7.6 | 28.7 |
| Published activities (excl software & mm works) | 330 | 13,227 | 991.9 | 403.9 | 30.5 |
| Motion picture and video production/distribution, Radio and television activities | 191 | 191 | 198.9 | 108.4 | 567.5 |
| Broadcasting | na | na | 115.8[1] | na | na |
| Dramatic arts, music and other arts activities | 153 | 409 | 20.7 | 6.2 | 15.2 |
| *Total creative content services* | *718* | *14,092* | *1,356.7* | *526.1* | *37.3* |
| **1990** | | | | | |
| IT Development | 184 | 2,102 | 222.6 | 61.5 | 29.3 |
| Published activities (excl software & mm works) | 343 | 16,097 | 1,869.4 | 724.7 | 45.0 |
| Motion picture and video production/distribution, Radio and television activities | 297 | 4,291 | 356.9 | 208.0 | 48.5 |
| Broadcasting | na | na | 196.0 [2] | na | na |
| Dramatic arts, music and other arts activities | 134 | 366 | 27.0 | 6.1 | 16.7 |
| *Total creative content services* | *958* | *22,856* | *2,671.9* | *1,000.4* | *43.8* |
| **2001** | | | | | |
| IT Development | 1,106 | 14,282 | 3,077.5 | 1,134.9 | 79.5 |
| Published activities (incl software & mm works) | 757 | 4,293 | 683.9 | 186.3 | 43.4 |
| Motion picture and video production/distribution, Radio and television activities | 334 | 4,988 | 910.4 | 180.9 | 36.3 |
| Broadcasting | 13 | 1,591 | 631.6 | 65.3 | 41.0 |
| Dramatic arts, music and other arts activities | 363 | 1,334 | 95.9 | 22.7 | 17.0 |
| *Total creative content services* | *2,573* | *26,488* | *5,399.4* | *1,590.2* | *60.0* |

[1] Figure is for Singapore Broadcasting Corporation for 1985

[2] Figure is for Singapore Broadcasting Corporation for year ended 1990

*Note*: The creative content sector includes the following industries: IT development; publishing; motion picture production, distribution & allied services; radio & television services, theatrical producers, entertainment

IT development has been included in both the KIBS sector and the creative content sector

*Sources*:

Singapore Department of Statistics (DOS). (Various years). *Economic Surveys Series: Business Services and Real Estate*. Singapore: DOS.

Singapore Department of Statistics (DOS). (Various years) *Economic Surveys Series: Community, Social & Personal Services.* Singapore: DOS.

Data obtained from DOS

**Table 2.9b Sectoral composition of creative content sector in Singapore, 1986-2001 (Percentage)**

| | Establishments | Employment | Operating Receipts | Value Added |
|---|---|---|---|---|
| **1986** | | | Percentage | |
| IT Development | 6.1 | 1.9 | 2.2 | 1.4 |
| Published activities (excl software & mm works) | 46.0 | 93.9 | 73.1 | 76.8 |
| Motion picture and video production/distribution, Radio and television activities | 26.6 | 1.4 | 14.7 | 20.6 |
| Broadcasting | na | na | 8.5 | na |
| Dramatic arts, music and other arts activities | 21.3 | 2.9 | 1.5 | 1.2 |
| *Total creative content services* | *100.0* | *100.0* | *100.0* | *100.0* |
| **1990** | | | Percentage | |
| IT Development | 19.2 | 9.2 | 8.3 | 6.2 |
| Published activities (excl software & mm works) | 35.8 | 70.4 | 70.0 | 72.4 |
| Motion picture and video production/distribution, Radio and television activities | 31.0 | 18.8 | 13.4 | 20.8 |
| Broadcasting | na | na | 7.3 | na |
| Dramatic arts, music and other arts activities | 14.0 | 1.6 | 1.0 | 0.6 |
| *Total creative content services* | *100.0* | *100.0* | *100.0* | *100.0* |
| **2001** | | | Percentage | |
| IT Development | 43.0 | 53.9 | 57.0 | 71.4 |
| Published activities (incl software & mm works) | 29.4 | 16.2 | 12.7 | 11.7 |
| Motion picture and video production/distribution, Radio and television activities | 13.0 | 18.8 | 16.9 | 11.4 |
| Broadcasting | 0.5 | 6.0 | 11.7 | 4.1 |
| Dramatic arts, music and other arts activities | 14.1 | 5.0 | 1.8 | 1.4 |
| *Total creative content services* | *100.0* | *100.0* | *100.0* | *100.0* |

See notes for Table 2.5a

*Sources*:

Singapore Department of Statistics (DOS). (Various years). *Economic Surveys Series: Business Services and Real Estate*. Singapore: DOS.

Singapore Department of Statistics (DOS). (Various years) *Economic Surveys Series: Community, Social & Personal Services.* Singapore: DOS.

Data obtained from DOS

## 3. Survey Methodology and Profile of Survey Respondents

To gain a perspective on how the actors in the three innovative sectors in the Singapore economy view the challenges that they face in pursuing or responding to innovation in the course of their business operations in Singapore, we conducted a small sample, explorative survey covering 45 firms drawn from the three sectors. This section provides a description of the survey instrument used and the sampling method adopted. The survey instrument employed is a semi-structured questionnaire that we designed jointly with the World Bank. The questionnaire covers a total of 80 questions, a large number of which are open ended in order to obtain a richer range of responses of various issues. Through these open ended questions, we tried to elicit qualitative information on various aspects of the respondents' business operations including:

a) Determinants of location choice
b) View on skills and preferences of sources for skills
c) Type of investments needed to extract value from creative capital
d) Firm level actions to improve efficiency and innovation capacity
e) Desired external factors to improve efficiency and innovation capacity
f) Views on prospects of IP industries
g) Views on relative strength of other cities in comparison to Singapore

From the open-ended responses provided by the respondents, we tried to identify commonalities and developed coding to group them into the identified categories.

The questionnaire was completed through a combination of assisted self-administration by respondents and face-to-face interviews[1]. To facilitate completion, the questionnaire was given to respondents ahead of the interview sessions. Each interview took around 60 to 90 minutes to complete, although a number of interviews lasted longer than two hours.

The sectoral composition of respondents is shown in the **Table 3.1**. Of the 45 firms covered in the survey, 16 are in high-tech manufacturing, 15 are in the knowledge intensive business services sector (KIBS) and 14 are in creative content industries. While the sample size is too small to achieve any realistic proportionate sampling, an attempt was consciously made to cover the spectrum of relevant players in each of the three industries in terms of spread of sub-industries (ensuring that most if not all relevant sub-industries of importance in Singapore are covered), size distribution (ensuring that there is a

[1] One interview was conducted over the telephone

good mix of smaller firms vs. large establishments), and ownership (local vs. foreign-majority controlled).

**Table 3.1: Composition of Survey Sample**

| Sector | # | % |
|---|---|---|
| High-tech sector | 16 | 35.6 |
| Electronics/ IT Manufacturing | 11 | 26.7 |
| Life Sciences | 5 | 8.9 |
| KIBS | 15 | 33.3 |
| Consultancy services | 3 | 6.7 |
| IT services | 2 | 4.4 |
| Legal services | 2 | 4.4 |
| Venture Capital/ Fund Management/ Financial Services | 6 | 13.3 |
| Other services | 2 | 4.4 |
| Media/ Creative/ Content sector | 14 | 31.1 |
| Print publishing | 2 | 4.4 |
| Software (including multimedia and games) | 9 | 20.0 |
| Others (film, drama production) | 3 | 6.7 |
| TOTAL | 45 | 100.0 |

**Table 3.2: Characteristics of Surveyed Companies**

| % of respondents where … | **High-tech** | **KIBS** | **Media/ creative** | **Overall** |
|---|---|---|---|---|
| **Ownership** | | | | |
| Govt/State agency have a financial stake | 31.3 | 0.0 | 28.6 | 20.0 |
| Foreign co/individual have a financial stake | 56.3 | 33.3 | 35.7 | 42.2 |
| Firm is foreign controlled | 56.3 | 33.3 | 14.3 | 35.6 |
| **Location** | | | | |
| Firm has plants, branches or subsidiaries elsewhere | 87.5 | 66.7 | 21.4 | 60.0 |
| Firm's headquarters is outside Singapore | 43.8 | 20.0 | 7.1 | 24.4 |
| **Export Propensity** | | | | |
| Firm exporting | 87.5 | 50.0 | 76.9 | 72.1 |
| Exports as % of total revenues | 62.3 | 48.3 | 34.1 | 50.2 |

In **Table 3.2**, the ownership and locational characteristics of the sampled firms are summarized. The large majority of the surveyed firms are privately owned, with only one-fifth having any degree of government ownership. There is a good mix of foreign and local firms in the sample, with the high-tech manufacturing sector being best represented by foreign-controlled firms. This is fairly representative of the situation in Singapore, where foreign manufacturers have a prominent presence, especially in the technology segment of the manufacturing industry.

The sample of companies are also quite internationalized, with more than half the firms having an overseas presence. In terms of both having overseas arms and being headquartered abroad, the high-tech

manufacturing sector is the most internationalized, while the creative content sector is the most domestic-bound. The majority of the surveyed firms are also quite globalized in terms of international trade. In the high-tech manufacturing and creative content sectors, most of the firms are exporting abroad. However, only half the KIBS firms have export activities.

The size of firms surveyed is shown in **Tables 3.3** and **3.4**. Overall, the sample includes representative shares of large, medium and small firms in all three sectors. The majority of the firms surveyed are in the small-medium category, in terms of both number of employees (majority employed fewer than 100 employees) and sales revenue (42.4% earned between $3 million to $100 million). The sample does include a sizeable number of large firms, with over one quarter employing over 100 people and around one quarter earning above $100 million.

**Table 3.3: Number of full time employees**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Less than 10 | 7.1 | 46.7 | 42.9 | 32.6 |
| Between 10 and 100 | 35.7 | 33.3 | 50.0 | 39.5 |
| Between 100 and 500 | 35.7 | 6.7 | 7.1 | 16.3 |
| 500 and more | 21.4 | 13.3 | 0.0 | 11.6 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 |

**Table 3.4: Annual Sales Revenue of Firm**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Small (Less than S$3 million) | 7.7 | 50.0 | 50.0 | 33.3 |
| Small-Medium (Between S$3 million to S$100 million) | 53.8 | 20.0 | 50.0 | 42.4 |
| Large (Above S$100 million) | 38.5 | 30.0 | 0.0 | 24.2 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 |

**Table 3.5: Age of company as of 2003**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Less than 5 years old | 43.8 | 40.0 | 57.1 | 46.7 |
| Between 5 to 10 years old | 12.5 | 13.3 | 35.7 | 20.0 |
| Between 10 to 20 years old | 18.8 | 33.3 | 7.1 | 20.0 |
| More than 20 years old | 25.0 | 13.3 | 0.0 | 13.3 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 |

The sampled firms are on the whole quite young, with almost half having been established less than five years ago (**Table 3.5**). This is more marked in the case of the respondent firms in the creative content industries, in line with the fact that the creative content industries has started to grow in importance in Singapore only in more recent years.

## 4. Survey Findings

### 4.1 Location Choice of Firms

This section highlights the factors that a firm considers when it makes the decision to locate its operations in a particular location. For firms that have the option to choose from a number of competing locations, the final choice reflects their assessment of a number of factors, which this part of the survey seeks to explore.

The majority of firms did not consider other locations apart from Singapore when making their initial location decisions, as seen in **Table 4.1.1** below. This was especially true of the creative content sector, where only 28.6% had considered other locations apart from Singapore. Firms in the high-tech manufacturing sector had the highest propensity to consider other cities apart from Singapore. This is probably due to the globalized nature of many of these high-tech firms. **Table 4.1.2** shows that firms with overseas presence are more likely to have considered other locations apart from Singapore: 48.1% of firms with overseas presence had done so, compared to only 33.3% of firms that have no overseas presence.

Among firms that did consider other cities outside of Singapore, most looked toward locations in Asian countries as possible alternatives. Cities in China and Malaysia, as well as Hong Kong were the most often named options.

**Table 4.1.1: Locations Initially Considered before Locating in Singapore**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No other location considered | 43.8 | 60.0 | 71.4 | 57.8 |
| Other location considered | 56.3 | 40.0 | 28.6 | 42.2 |
| City in Asia | 43.8 | 26.7 | 28.6 | 33.3 |
| City in USA | 12.5 | 6.7 | | 6.7 |
| Asia and USA | | 6.7 | | 2.2 |
| TOTAL | 100 | 100 | 100 | 100 |

**Table 4.1.2: Locations Initially Considered Singapore by Overseas Presence**

| | Firm does not have Overseas Plants, Branches or Subsidiaries | Firm has Overseas Plants, Branches or Subsidiaries | Overall |
|---|---|---|---|
| No other location considered | 66.7 | 51.9 | 57.8 |
| Other location considered | 33.3 | 48.1 | 42.2 |
| TOTAL | 100.0 | 100.0 | 100.0 |

In all three sectors, the main reason for choosing to locate in Singapore initially is that Singapore was the home-base for the founders or key decision makers in the firms (**Table 4.1.3**). The significance of the home-base reason is that firms have established business networks and contacts as well as a natural familiarity with the business environment in Singapore. Other than that, the most common reason for choosing to locate in Singapore initially is the strength of Singapore's infrastructure, with companies citing the business infrastructure, communications and information technology among Singapore's attractions. The appeal of Singapore's sound infrastructure was especially appreciated by the high-tech manufacturing firms.

Firms in the creative content sector were also influenced by Singapore's position as an international hub for many business activities, with 21.4% basing their companies here for that reason. These firms emphasized that Singapore was ideal as a headquarters location for the ASEAN and Asia Pacific regions because it is "well-connected regionally".

**Table 4.1.3: Main Reason for Initially Locating in Singapore**

| | High-tech | KIBS | Media/creative | Overall |
|---|---|---|---|---|
| Home-base | 50.0 | 50.0 | 42.9 | 47.7 |
| Infrastructure | 37.5 | 14.3 | 7.1 | 20.5 |
| Hub | | 7.1 | 21.4 | 9.1 |
| Proximity To Markets/ Production Base | | 7.1 | 7.1 | 4.5 |
| Familiarity | 6.3 | | 7.1 | 4.5 |
| Acquisition | 6.3 | | | 2.3 |
| Client Relationship | | 7.1 | | 2.3 |
| Government | | 7.1 | | 2.3 |
| International City | | | 7.1 | 2.3 |
| Market Opportunities | | 7.1 | | 2.3 |
| Pioneering Opportunities | | | 7.1 | 2.3 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

Unsurprisingly, the home-base reason is more commonly expressed by firms that did not initially consider other locations apart from Singapore. As seen in **Table 4.1.4**, 60% of such firms located in Singapore because the island is their home-base. For firms that considered other locations, only 31.6% eventually settled in Singapore for this reason. These firms cited quite varied reasons for choosing Singapore, with the strength of Singapore's infrastructure finding much support. Naturally, the small

domestic market was not mentioned as a factor in any of the firms' decisions. However, one life sciences company explained that its decision was based on its familiarity with its immediate market, which is the cluster of related-industries located in Singapore. One film production company acknowledged that the market size in Singapore was small but at the same time identified crucial pioneer status opportunities from being the first mover in an infant industry.

**Table 4.1.4: Reason for Initially Locating in Singapore by Original Location Choice**

| | No other locations considered | Considered other locations |
|---|---|---|
| Homebase | 60.0 | 31.6 |
| Infrastructure | 12.0 | 31.6 |
| Hub | 12.0 | 5.3 |
| Familiarity | 4.0 | 5.3 |
| Proximity To Markets/ Production Base | 4.0 | 5.3 |
| Acquisition | 4.0 | |
| Client Relationship | | 5.3 |
| Government | 4.0 | |
| International City | | 5.3 |
| Market Opportunities | | 5.3 |
| Pioneering Opportunities | | 5.3 |
| TOTAL | 100.0 | 100.0 |

**Table 4.1.5: Singapore as Location Today**

| % of firms that believe … | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Firm is likely to decide to be located in Singapore if decision is made today | 75.0 | 66.7 | 75.0 | 72.5 |

The surveyed firms were also asked to assess the attractiveness of Singapore as a location today. This allowed firms to reassess their past location decisions in light of what they now know about operating their businesses in Singapore, and the opportunities and attractions presented by alternative locations.

In **Table 4.1.5**, it is seen that the majority of firms, 72.5%, believe that they would still choose Singapore if the location decision is made today. This proportion is slightly higher for creative content and high-tech manufacturing sectors (75%) vs. 66.7% for KIBS firms.

Several respondents mentioned that it is not straightforward to draw a conclusion on whether Singapore is still an ideal location and whether they would continue to choose to locate their business here. There are many factors for and against Singapore and weighing the two sides is not always clear-cut. Although on the balance, most of these firms stated they would still choose to reside in Singapore, some were cautious in their assessment, citing potential drawbacks such as high costs, lack of "openness" toward innovation and small market size.

For firms that would choose not to locate in Singapore, the main considerations are market factors, as seen in **Table 4.1.6** below. This is not so much a criticism of Singapore, but the fact that larger markets exist elsewhere. In their explanations, these firms repeatedly mention that they would prefer to locate in countries such as China or India, due to the large size of the markets there that are either already developed or are emerging. This reasoning was prominent among the high-tech manufacturing firms. Other reasons that were mentioned by high-tech manufacturing firms were related to resources, cost issues and the business environments of alternative locations. For KIBS firms, resource availability was also cited, whereas for creative contents, more favorable business environment in other locations were of equal importance as market factors. On further probing, this appears to refer to less stringent controls and regulation over content publishing in the alternative countries.

**Table 4.1.6: Reasons to relocate elsewhere if decision is made today**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Cost factors - cheaper to go elsewhere | 20.0 | 0.0 | 0.0 | 10.0 |
| Market factors - other locations provide access to large emerging markets | 60.0 | 66.7 | 50.0 | 60.0 |
| Resources - manpower, capital and talent | 20.0 | 33.3 | 0.0 | 20.0 |
| Business environment in other locations conducive | 40.0 | 0.0 | 50.0 | 30.0 |

*Note*: %'s do not add to 100% as multiple responses are included

For the companies that would still decide to locate in Singapore today, one reason that was commonly cited in all three sectors is Singapore's location as a hub with proximity and access to global markets (**Table 4.1.7**). Respondents make special mention of Singapore's ideal position as a regional hub for South East Asia and the Asia Pacific regions. This was an especially strong attraction for the KIBS sector, with 75% citing this as among the factors influencing their decision to stay in Singapore. For the high-tech manufacturing sector, Singapore's business infrastructure (communications, transportation, finance) was highlighted. This factor was far less important in the creative content sector, with only 33.3% mentioning it.

Apart from Singapore' hub position, the other factor that featured prominently in all three sectors is Government support (more so for high-tech manufacturing firms). Generally, it is felt that the government is strongly supportive of businesses and technology-focused businesses in particular. This support is seen in low corporate taxes and various assistance schemes, including grants, subsidies and training. Firms in the both the high-tech sector and creative content sector mention incentive schemes provided by the Singaporean government for firms in specific sectors (life-sciences, software development) as well as subsidies for innovation development.

**Table 4.1.7: Reasons to still locate in Singapore if decision is made today**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Location as hub,/ international city with proximity and access to global markets | 38.5 | 75.0 | 33.3 | 46.7 |
| Business infrastructure | 61.5 | 37.5 | 33.3 | 46.7 |
| Government support and incentives | 46.2 | 25.0 | 33.3 | 36.7 |
| Availability of manpower and skills | 30.8 | 12.5 | 0.0 | 16.7 |
| Market and Business Opportunities | 7.7 | 12.5 | 22.2 | 13.3 |
| Sound regulatory environment (including protection of IP) | 30.8 | 0.0 | 0.0 | 13.3 |
| Firm is familiar with Singapore/ has history in Singapore | 15.4 | 12.5 | 11.1 | 13.3 |
| Social infrastructure | 7.7 | 12.5 | 0.0 | 6.7 |
| Political Stability | 7.7 | 12.5 | 0.0 | 6.7 |

*Note*: %'s do not add to 100% as multiple responses are included

### 4.2 Efficiency of Firms

In the face of competition, a firm's success depends on its efficiency in using its resources to minimize costs and maximize output. This section explores the reasons for firms' current efficiencies and inefficiencies and the changes that firms believe will help them to achieve higher levels of efficiency.

Firms were first asked to think about the operational areas in which they considered themselves to be amongst the most efficient in their respective markets. They were then asked to identify the key factors that contribute to their strength in these areas. This helped to focus the analysis on the factors that differentiated firms sufficiently from their competitors to place them as best-practices companies in their industry.

**Table 4.2.1** shows the collated results from the interview responses. The list of open-ended answers were categorized into four groups. Overall, the main reasons for firms' superior efficiency were related to their Human Resources, with 53.3% giving reasons in this category, and 26.7% citing reasons tied to skills of their employees. Some respondents spoke generally of having skilled manpower, while others mentioned specific capabilities, such as "technical capability to adapt to production process", and

"large-scale IT project planning and systems integration". Other than skill-related factors, the quality of HR was mentioned in terms of knowledge, experience and attributes such as passion and creativity.

One notable difference between the three sectors is observed. The creative content sector was highly focused on HR-related reasons for their efficiency, with 71.4% giving reasons in this category. In contrast, the reasons given by firms in KIBS sector were more evenly spread across categories. While one-third mentioned HR-related reasons, another third gave reasons that were related to organizational factors, such as organizational structure. As an example, one firm said that their efficiency stems from their "flat organizational structure and well-integrated team", while another attributed their strength to their internationalized structure with a "network of overseas offices, contacts …"

The high-tech manufacturing sector also showed a greater spread of reasons for firm efficiency. Apart from the quality of Human Resources, high-tech firms also leverage on external factors as well as superior internal processes and systems. For example, one IT manufacturer specified its "efficient inventory deployment, cost-effective networking" as the reasons for its efficiency.

Having examined the factors contributing to firm efficiency, the analysis turns to factors that lead to sub-par performance in areas where firms believe they lag the most compared to best practices in the market. **Table 4.2.2** tabulates the main reasons for such inefficiencies. 37.8% of the firms felt that the main reason for inefficiency was related to resource constraints. For the high-tech manufacturers, finance and cost are the major issues, while the creative content sector faces the additional problem of small-sized firms which cannot develop economies of scale to improve efficiency. In the creative content sector, the lack of experience and expertise of staff was also of concern to 21.4% of the firms.

In **Tables 4.2.3** and **4.2.4**, the changes needed to improve efficiency are tabulated. **Table 4.2.3** shows the changes that firms stated as being needed internally, while **Table 4.2.4** refers to changes external to the firm.

A broad range of internal changes were cited, from strategic level decisions to reprioritize focus to process improvement and increased resource levels. Overall, the most commonly cited changes are in the category of improving and increasing firms' resources, especially human resources. 22.2% of firms believed that hiring new people and/ or upgrading the skills of existing personnel would solve their inefficiency problems. The hiring and training course of action was mainly in response to inefficiencies that were attributed to lack of expertise and experience.

**Table 4.2.1: Main Reason for Efficiency in Firm**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No reason | 12.5 | 13.3 | 14.3 | 13.3 |
| ***Skills/ Knowledge/ Attitude of HR*** | ***56.3*** | ***33.3*** | ***71.4*** | ***53.3*** |
| Creativity/Creativity and technology combined | 0.0 | 0.0 | 14.3 | 4.4 |
| Domain knowledge | 6.3 | | | 2.2 |
| Experience | 12.5 | 6.7 | 7.1 | 8.9 |
| Good attitude and innovation | | | 7.1 | 2.2 |
| Local knowledge | 6.3 | | | 2.2 |
| Passion | | | 7.1 | 2.2 |
| Retained knowledge | | 6.7 | | 2.2 |
| Skills of human resources | 31.3 | 20.0 | 28.6 | 26.7 |
| Small team | | | 7.1 | 2.2 |
| ***Organizational Factors*** | ***6.3*** | ***33.3*** | ***7.1*** | ***15.6*** |
| Company leadership | | 6.7 | | 2.2 |
| Management team in one location | | 6.7 | | 2.2 |
| Organizational structure | | 6.7 | | 2.2 |
| Organization's ability to respond to change | | 6.7 | | 2.2 |
| Organization's global network | | 6.7 | | 2.2 |
| Relationships with customers/ principals | 6.3 | | 7.1 | 4.4 |
| ***External Factors*** | ***12.5*** | ***13.3*** | ***7.1*** | ***11.1*** |
| Available opportunities | | 6.7 | | 2.2 |
| Leverage on support organization | | | 7.1 | 2.2 |
| Regional talent pool | 12.5 | 6.7 | | 6.7 |
| ***Internal Systems/ Processes*** | ***12.5*** | ***6.7*** | ***0.0*** | ***6.7*** |
| Cost effective solutions | 6.3 | | | 2.2 |
| Processes | 6.3 | 6.7 | | 4.4 |
| TOTAL | 100 | 100 | 100 | 100 |

**Table 4.2.2: Main Reason for inefficiency**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No reason | 18.8 | 26.7 | 14.3 | 20.0 |
| ***Resource Constraints*** | ***37.5*** | ***33.3*** | ***42.9*** | ***37.8*** |
| Finance/ cost | 25.0 | 13.3 | 21.4 | 20.0 |
| Lack of economies of scale/ Small size | 12.5 | 6.7 | 21.4 | 13.3 |
| Resource changes | | 6.7 | | 2.2 |
| Staff turnover | | 6.7 | | 2.2 |
| ***Lack of Skills/ Experience*** | ***12.5*** | ***13.3*** | ***21.4*** | ***15.6*** |
| Lack of experience | 6.3 | | 7.1 | 4.4 |
| Lack of expertise | 6.3 | 13.3 | 14.3 | 11.1 |
| ***Internal Organizational Factors*** | ***25.0*** | ***13.3*** | ***7.1*** | ***15.6*** |
| Employee mindset | | 6.7 | | 2.2 |
| Idealism | | | 7.1 | 2.2 |
| Internal bureaucracy | | 6.7 | | 2.2 |
| Unable to exploit created IP | 6.3 | | | 2.2 |
| Lack of supporting structure | 6.3 | | | 2.2 |
| Not enough strategic focus | 6.3 | | | 2.2 |
| Sales people product focused | 6.3 | | | 2.2 |
| ***External Factors*** | ***6.3*** | ***13.3*** | ***14.3*** | ***11.1*** |
| Industry in early stage | | 6.7 | 7.1 | 4.4 |
| Lack of presence in some markets | | 6.7 | 7.1 | 4.4 |
| Regulatory requirements | 6.3 | | | 2.2 |
| | 100.0 | 100.0 | 100.0 | 100.0 |

Other than this, there was no consistent mapping of reasons for inefficiencies to internal changes needed. For example, among the firms that cited cost constraints as the reason the inefficiencies, a whole host of internal changes were suggested, running the gamut from increasing budgets to improving communications to restructuring the company to upgrading of technology. In response to inefficiencies caused by lack of economies of scale, companies suggest a variety of changes such as upgrading technology, speeding up processes and changing the ownership structure of the firm.

In **Table 4.2.4**, we see that the suggested changes to take place outside of the firm are similarly varied. As a group, market related factors were most commonly cited. These include changes such as improved market conditions, more competitive market and increased market size for specific products and services. One firm elaborated on the challenges faced by new local firms who are unable to secure orders from the large domestic companies in Singapore. These can be overcome if large customers are willing to make a change to transact with newer companies with shorter track records.

**Table 4.2.3: Change within Firm to improve efficiency**

| | High-tech | KIBS | Media/creative | Overall |
|---|---|---|---|---|
| None | 12.5 | 33.3 | 21.4 | 22.2 |
| | | | | |
| ***Strategic changes*** | ***18.8*** | ***6.7*** | | ***8.9*** |
| Align vision | | 6.7 | | 2.2 |
| Focus on IP | 6.3 | | | 2.2 |
| Marketing as priority | 6.3 | | | 2.2 |
| Outsourcing | 6.3 | | | 2.2 |
| | | | | |
| ***Implement/ Improve Processes*** | ***12.5*** | ***13.3*** | ***7.1*** | ***11.1*** |
| Automation | | 6.7 | | 2.2 |
| Improve communication | 6.3 | | 7.1 | 4.4 |
| Process for response | | 6.7 | | 2.2 |
| Speed up development and production process | 6.3 | | | 2.2 |
| | | | | |
| ***Improve/ Increase Resources*** | ***31.3*** | ***33.3*** | ***21.4*** | ***28.9*** |
| Dedicated manpower | 6.3 | | | 2.2 |
| Hire and/or train | 18.8 | 33.3 | 14.3 | 22.2 |
| Upgrade technology | 6.3 | | 7.1 | 4.4 |
| | | | | |
| ***Financial Resources*** | ***12.5*** | ***0.0*** | ***21.4*** | ***11.1*** |
| Budget increase | 12.5 | | 7.1 | 6.7 |
| Implement cost-revenue model | | | 7.1 | 2.2 |
| Resource allocation | | | 7.1 | 2.2 |
| | | | | |
| ***Organizational Factors*** | ***12.5*** | ***13.3*** | ***28.6*** | ***17.8*** |
| Accountability for IP commercialization | 6.3 | 0.0 | | 2.2 |
| Better management practices | | | 7.1 | 2.2 |
| Better planning & forecasting | | | 7.1 | 2.2 |
| Change leadership | 6.3 | | | 2.2 |
| Decentralize decision making | | 6.7 | | 2.2 |
| More independent ownership | | | 7.1 | 2.2 |
| Relocate senior executives to markets | | | 7.1 | 2.2 |
| Remodel organization | | 6.7 | | 2.2 |
| Total | 100 | 100 | 100 | 100 |

**Table 4.2.4: Change outside of Firm to improve efficiency**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| None | 6.3 | 46.7 | 14.3 | 22.2 |
| ***Changes in Market Factors*** | ***31.3*** | ***26.7*** | ***14.3*** | ***24.4*** |
| Ability to hire more good talent | 6.3 | | | 2.2 |
| Change outside impression of firm | | 6.7 | | 2.2 |
| Domestic large customers prepared to transact with new companies | 6.3 | | | 2.2 |
| Economic growth/ market conditions | 6.3 | 6.7 | | 4.4 |
| Investors' perceptions | 6.3 | | | 2.2 |
| Larger market | | | 7.1 | 2.2 |
| More competition | | 6.7 | 7.1 | 4.4 |
| Reduce overcapacity | 6.3 | | | 2.2 |
| Vibrant exit market | | 6.7 | | 2.2 |
| ***Government Support*** | ***6.3*** | ***6.7*** | ***14.3*** | ***8.9*** |
| Financing for SMEs | 6.3 | 6.7 | | 4.4 |
| Government support for local industry/new firms | | | 14.3 | 4.4 |
| ***Regulatory Environment*** | ***18.8*** | ***0.0*** | ***14.3*** | ***11.1*** |
| Deregulation | | | 7.1 | 2.2 |
| Streamline regulatory framework | 18.8 | | | 6.7 |
| Transparent public sector | | | 7.1 | 2.2 |
| ***Cost*** | ***12.5*** | ***0.0*** | ***14.3*** | ***8.9*** |
| Reduced cost | 6.3 | | | 2.2 |
| Reduced cost structures | 6.3 | | 14.3 | 6.7 |
| ***External Relations*** | ***12.5*** | ***20.0*** | ***21.4*** | ***17.8*** |
| Outsourcing | 6.3 | 13.3 | | 6.7 |
| Partnership | | 6.7 | | 2.2 |
| Purchase by global player | | | 7.1 | 2.2 |
| Strategic partnerships | 6.3 | | 14.3 | 6.7 |
| ***Others*** | ***12.5*** | ***0.0*** | ***7.1*** | ***6.7*** |
| Education | | | 7.1 | 2.2 |
| Measurement of R&D | 12.5 | | | 4.4 |
| Total | 100 | 100 | 100 | 100.0 |

In the high-tech sector, 18.8% of companies felt that the regulatory framework in Singapore needs to be more streamlined. One firm spoke of needing "reduced unnecessary regulatory demand" while another firm was more specific in mentioning that "a stream-lining of listing requirements may improve the ability of the company to access funds". Several firms in this sector also felt that having reliable measures of R&D would enable them to benchmark against standards in their industry and assess the rate of return on R&D investment.

### 4.3 Innovation and Intellectual Property

In the context of Singapore, low-cost competition has emerged in recent years with the rising importance of other South East Asian countries and China as production centers. For Singapore-based firms, this has meant needing to seek other ways of differentiating themselves from the competition. One avenue is to produce proprietary products, services or content that can be protected under Intellectual Property (IP) laws through ownership of patents, trademarks and copyrights. Indeed, in recent years, the creation of IP in Singapore has increased significantly; for example, the cumulative number of US patents granted to Singapore-based inventors has doubled between 1999 and 2002, and the level of patenting intensity (patent per capita) in Singapore had exceeded some advanced OECD countries (Wong and Ho, 2003). This section deals with the extent to which the sample firms are involved with IP, the constraints they face and what can be done to increase efforts to produce outputs covered by IP law.

**Table 4.3.1** shows the extent to which firms are producing output covered by IP law. All the high-tech manufacturing firms and almost all of the firms in the creative content industry do so. The proportion of firms producing IP protected output is lower in the KIBS sector, at 60% of firms. Among firms not currently producing IP protected products, a number of reasons are given including: lack of direct applicability of IP laws to their main product/ service line, immaturity of industry in Singapore and the huge cost of producing IP protected outputs.

**Table 4.3.1: Extent of Firms' Involvement in Producing Products/ Services/ Content Covered by IP Law**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| % of Firms that produce outputs covered by IP law | 100.0 | 60.0 | 92.9 | 84.4 |
| % of Firms that licenses IP to others | 62.5 | 23.1 | 42.9 | 44.2 |
| % of Firms involved in dispute pertaining to IP | 18.8 | 21.4 | 23.1 | 20.9 |
| % of Firms seeking innovation that can be protected by IP law | 87.5 | 53.3 | 71.4 | 71.1 |
| For firms seeking innovation, Average % of revenue directed toward innovation | 12.2 | 21.0 | 41.9 | 23.1 |

Incidence of licensing IP to others is highest in the high-tech manufacturing sector, with 62.5% of firms having done this, compared to 42.9% of the creative content firms and only 23.1% of KIBS firms. However, a relatively low proportion of high-tech manufacturers have been involved in IP disputes (18.8%) compared to 23.1% of creative content firms. In the creative content sector, disputes usually arise over final ownership of jointly produced or jointly authored content and products.

Above their current IP activities, 71.1% of firms overall are actively seeking innovations that can be protected by IP law. This propensity is highest among high-tech manufacturers (87.5%) and lowest among KIBS firms (53.3%). However, in terms of investment in seeking IP protected innovations, high-tech firms on average indicated investments amounting to 12.2% of revenue, compared to 21% for KIBS firms and a rather high 41.9% for the creative content firms[2].

As shown in **Table 4.3.2**, 42.2% of firms overall do not feel that that there are any major constraints to seeking innovations covered by IP law. This was especially true in the KIBS sector, where 73.3% of those seeking IP protected outputs do not foresee any major barriers standing in the way of the efforts.

**Table 4.3.2: Major Constraints to Seeking Innovative Products covered by IP Law**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| None | 18.8 | 73.3 | 35.7 | 42.2 |
| Core business is not innovation focused | 6.3 | | | 2.2 |
| ***Cost Constraints*** | | | | |
| Costs involved | 43.8 | 13.3 | 35.7 | 31.1 |
| Justifying funding | | | 7.1 | 2.2 |
| Difficulty to achieve successful commercialization of IPR | 6.3 | | | 2.2 |
| ***Legal Issues*** | | | | |
| Enforcing IP law | 6.3 | | 7.1 | 4.4 |
| Liaising with other IP rights holders | 6.3 | | | 2.2 |
| Limited laws for innovation in processes and business systems | | 6.7 | | 2.2 |
| Locality of scope of control of IP law | 6.3 | | | 2.2 |
| Parallel imports | | | 7.1 | 2.2 |
| ***Resource Shortage*** | | | | |
| Lack of knowledge of IP | 6.3 | | | 2.2 |
| Limited manpower | | 6.7 | | 2.2 |
| Skill to develop content | | | 7.1 | 2.2 |
| TOTAL | 100 | 100 | 100 | 100 |

[2] Includes one company that spends 100% of its revenue on seeking IP protected innovations

Among the firms that do face constraints, the high cost involved in innovation and seeking IPR protection was the most oft-mentioned constraint. 43.8% of high-tech manufacturers find this to be the case, while 35.7% of the creative content firms also felt this way. The cost constraints mentioned the high direct costs of investing in innovation and obtaining IPR licenses as well as perceived difficulties in securing funding. One firm spoke specifically of the problem of "Financial resources to invest in R&D, high cost of patent applications & protection", while another lamented the "limited accessibility of R&D funding by SMEs" and a third firm mentioned the lack of "funding to secure licensing or technology transfer".

Legal issues were also mentioned by a number of firms. One high-tech manufacturer felt that local enforcement was weak with "local courts of law tending to sympathize and protect local producers who may have infringed IPR." Other issues related to IP laws include concern over the scope of control of IP law for products or services that are designated for overseas markets and the lack of IP protection for innovations in the areas of processes and business systems.

**Table 4.3.3** tabulates the suggestions on the types of changes within firms that would help most in enabling firms to increase efforts to produce outputs covered by IP laws. The responses are categorized into seven broad areas. Close to half the firms had no opinion on what internal changes would help. Of those that offered suggestions, improving and increasing both manpower and financial resources was frequently mentioned.

**Table 4.3.3: Changes within Firm to Increase Efforts to Produce IP Protected Output**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| None | 37.5 | 60.0 | 42.9 | 46.7 |
| Improve awareness of, exposure to and communicate importance of IP | 6.3 | 0.0 | 21.4 | 8.9 |
| Funding and commit financial resources to IP | 12.5 | 13.3 | 7.1 | 11.1 |
| Focus and prioritization of IP | 12.5 | 6.7 | 7.1 | 8.9 |
| Increase and Improve Manpower Resources | 12.5 | 20.0 | 14.3 | 15.6 |
| Foster culture and mindset conducive to innovation | 18.8 | 0.0 | 0.0 | 6.7 |
| Closer external ties with IP developers | 0.0 | 0.0 | 14.3 | 4.4 |
| Other Internal changes | 12.5 | 6.7 | 0.0 | 6.7 |

*Note*: %'s do not add to 100% as multiple responses are included

There are some notable differences between the sectors. In the KIBS sector, the most frequently cited change is in the manpower or human resource area. Companies in this sector spoke of developing "resources (i.e. technical) which can and want to develop IP" and "continuous training of staff in our philosophy". In the high-tech manufacturing sector, we observe an emphasis among many firms on

fostering a culture and mindset conducive to innovation. High-tech manufacturers spoke of a need for "change of mindset from distributor to product owners", "fostering a more creative culture" and developing a "culture of innovation through training and exploration". In the creative content sector, almost a quarter of firms felt that they need to do more to improve awareness and understanding of IP. One firm emphasized that it needed to focus on "awareness creation/ education for clients internally on the importance of IP and the cost of using it". Other firms spoke about specifically needing "more understanding of IP contracts and processes" and "more exposure to inventions and innovations arising from academic research".

**Table 4.3.4** shows the suggestions for changes outside the firm that would be most helpful to enable firms to increase efforts to produce IP protected outputs. The responses varied greatly and are grouped into nine broad groups. Again, a large proportion of firms, 40%, offered no opinion on the types of external changes which would be helpful to them. 66.7% of the KIBS firms did not provide any response to this line of enquiry.

**Table 4.3.4: Changes Outside Firm to Increase Efforts to Produce IP Protected Output**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| None | 18.8 | 66.7 | 35.7 | 40.0 |
| Government funding, subsidies, incentives, tax breaks | 25.0 | 0.0 | 14.3 | 13.3 |
| Changes to and better enforcement of IP protection laws | 6.3 | 6.7 | 21.4 | 11.1 |
| Reduce cost of IP investment, application and maintenance of protection | 12.5 | 6.7 | 7.1 | 8.9 |
| External partnership and ties with research institutes and legal resources | 12.5 | 6.7 | 0.0 | 6.7 |
| More demand for IP from marketplace | 0.0 | 6.7 | 14.3 | 6.7 |
| Better recognition, understanding and education on IPR generally | 6.3 | 0.0 | 14.3 | 6.7 |
| Harmonized Global IP Laws | 12.5 | 0.0 | 0.0 | 4.4 |
| Mature supporting industries and infrastructure for IP products | 0.0 | 0.0 | 14.3 | 4.4 |
| Other external changes | 12.5 | 0.0 | 0.0 | 4.4 |

*Note*: %'s do not add to 100% as multiple responses are included

Of the reasons that were cited, the most popular are those related to government assistance to firms. These may be in the form of funding such as grants or incentives such as tax breaks. One quarter of high-tech manufacturers believe that such government initiatives are needed, specifically mentioning support for R&D activities, in statements such as "higher governmental R&D funding support", "R&D subsidy from government" and "tax breaks for recovery of R&D investments – especially those that are successfully commercialized".

Another area that received strong support is the need for better enforcement of IP protection law, especially those in the creative content sector, as demonstrated by one firm's comment on "greater enforcement of IP law and lost-cost methods to enforce it." The reduction of cost involved in producing and maintaining IP outputs was also mentioned by a number of firms. One representative statement refers to the "ease and cost effectiveness of application and subsequent maintenance of potential IP".

It has been established that the majority of firms are producing IP protected outputs and the majority of firms are also actively seeking innovations that can be turned into IP protected outputs. In examining the constraints faced by firms and suggestions to improve efforts to produce IP outputs, the issue of IP laws was brought up by a number of respondents.

To end this section, the importance of an effective IP law regime to firms is analyzed. The first half of **Table 4.3.5** shows that overall, 84.4% of the surveyed firms believed that effective IP laws are important to their industry. All the high-tech manufacturers held this view, compared to 85.7% of the creative content firms and 66.7% of the KIBS firms. The proportion that consider an effective IP law regime to be important to their own firms is lower, at 68.9% overall. Among high-tech manufacturers, this proportion was 87.5%, the highest of the three sectors, while only 46.7% of KIBS firms felt that effective IP laws were important to their own firms.

The second half of **Table 4.3.5** summarizes the importance of effective IP laws to both firms and industry. The KIBS firms have the highest propensity to believe that effective IP laws are not all that important. 25% of KIBS firms believe effective IP regime to be unimportant both to their industry and to their own firms. This compares to 14.3% of creative content firms and 0% of high-tech firms.

**Table 4.3.5: Importance of Effective IP Law Regime**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Important in firm | 87.5 | 46.7 | 71.4 | 68.9 |
| Important in industry | 100.0 | 66.7 | 85.7 | 84.4 |
| | | | | |
| Important in both firm and industry | 87.5 | 58.3 | 71.4 | 73.8 |
| Important in industry but not in firm | 12.5 | 16.7 | 14.3 | 14.3 |
| Not important in both firm and industry | 0.0 | 25.0 | 14.3 | 11.9 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 |

In conclusion, it appears that the high-tech manufacturing sector is the most advanced of the creative industries in terms of current levels of involvement in the area of IP. Firms in this sector are the most likely to be currently producing outputs covered by IP law, show the highest propensity to further seek innovations covered by IP law and are the most emphatic about the importance of an effective IP law

regime for their industry. In contrast, firms in the KIBS sector appear to have the most ground to make up in this aspect of evolving from efficiency to innovation.

### 4.4 Innovation enablers

Obtaining appropriate labor to facilitate their innovation efforts appears to be a common concern for firms in all the three innovative sectors. Most firms in our sample (87.5%) report that the supply of innovators – those who develop new ideas and transform them into intellectual property - is a real issue for them (see **Table 4.4.1**). The need is especially acute in the high-tech and creative content sectors, whose survival is more directly linked to developing innovative products and services, than for the KIBS firms, who provide a supporting role for them. Nevertheless, over three-quarters of KIBS firms also report that obtaining innovators is an issue for them; not only to innovate their own companies, but because of their interdependence on the other two sectors. Investment firms, for example, need innovative people and companies to invest in.

**Table 4.4.1: Supply of enablers of innovation**

| Is the supply of innovators a real issue for your company? | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No | 9.4 | 21.4 | 7.1 | 12.5 |
| Yes | 90.6 | 78.6 | 92.9 | 87.5 |
| Total | 100 | 100 | 100 | 100 |

*Note*: One company answered 'yes and no'. Its response is split half for each

The main issue in the supply of innovators appears to have been a prevailing culture in Singapore that until recently may have discouraged creativity, risk-taking, and failure. Although a few companies report the need for people with further training and greater expertise, the majority point to the lack of innovative and entrepreneurial spirit in society as a whole. Based on the annual surveys of the Global Entrepreneurship Monitor (GEM), Singapore has ranked relatively low in the propensity of her adult population engaging in starting up new businesses; in 2003, only 5% of Singapore's adult population engaged in new start-up activities, significantly below that in the US (11.9%) or China (11.7%), and ranking 21$^{st}$ out of 31 countries covered (Wong et. al. 2004). A major factor contributing to the relative lack of entrepreneurial participation appears to have been the high opportunity cost, given that Singapore had enjoyed full-employment for many years, and a generation of young educated people had experienced rapid career advancement and steady and secure income growth working in subsidiaries of global MNCs or the public sector. In this sense, Singapore is a paradox of her past success in creating rapid economic growth through leveraging foreign MNCs (Wong, 2002).

Other issues are more industry-specific. Older industries within the high-tech sector, which are no longer considered glamorous, have difficulties attracting talent. At the other end of the spectrum is the creative content sector, which is relatively young. Small companies in these industries find it difficult to compete for talent in a highly regulated sector dominated by large, state-owned media firms.

Given these issues, it is not surprising that the major characteristics firms look for in innovators are creativity, open-mindedness (those who are able to think 'out-of-the-box') and willingness to take risks (**Table 4.4.2**). However, creativity alone is not enough; it must be combined with expertise in the relevant area. Firms also need innovators who have a combination of skills, combining business savvy with technological skills. Technical expertise is particularly important for high-tech manufacturing firms.

**Table 4.4.2: Characteristics of people most helpful in enabling innovation**

| | Percentage of respondents |
|---|---|
| Creative, open-minded | 31.0 |
| Cross-discipline/combination of skills | 19.0 |
| Technology or technical savvy | 16.7 |
| Daring, bold, visionaries | 11.9 |
| Entrepreneurial | 7.1 |
| Other | 14.3 |
| Total | 100 |

The lack of innovators in Singapore is marked enough that most firms (67.4%) report lacking some skill or ability such that their innovation activity is hampered (**Table 4.4.3**). This lack is most prevalent in the high-tech sector, where 81.3% of firms reported this problem, while the comparable figure for KIBS was only 69.2%. The creative content companies face this problem least frequently (50%), perhaps because a more pressing concern for them is market development, given limited market demand and the relative newness of the industry.

**Table 4.4.3: Absence of particular skills or abilities that hinder innovation**

| Is there any particular skill or ability whose absence has prevented firm from being more innovative? | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No | 18.8 | 30.8 | 50.0 | 32.6 |
| Yes | 81.3 | 69.2 | 50.0 | 67.4 |
| Total | 100 | 100 | 100 | 100 |

Firms are not very optimistic about finding the skills they need in the current local labor market. Only 19.6% said they would look for a national in the local market (**Table 4.4.4**). The most likely

sources of innovative manpower are nationals from the regional market (28.6% of companies who report a lack of such skills).

**Table 4.4.4: Characteristics of most likely source of innovators**

| | Percentage of firms who lack a skill/ability |
|---|---|
| National from regional market | 28.6 |
| National from local market | 19.6 |
| Expat from N.America/Europe | 16.1 |
| Expat from regional market | 14.3 |
| National from N.America/Europe | 14.3 |
| Expat from local market | 7.1 |
| Total | 100.0 |

*Note*: One company ticked both national from local market and expat from N. America/Europe, and two companies ticked both National or expat from N. America/Europe. Their responses were split half to each

Overall, 52.4% of companies have employed people from other cities as a substitute for skills which are scarce in Singapore, although KIBS companies do so much less frequently than those in the other two sectors. Firms which employ this generally find this arrangement works well (**Table 4.4.5**). Such arrangements vary according to the needs of the firm: it may involve employing staff from overseas, engaging consultants from other countries, sending staff for training, or outsourcing. The countries involved are widespread, including the US, Europe, ASEAN, China, India, Canada, Taiwan and Japan.

**Table 4.4.5: Substitution of skills that are scarce in Singapore by using people located elsewhere**

| Has the firm tried to substitute for skills that are scarce in Singapore by using people located elsewhere? | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No | 40.0 | 64.3 | 38.5 | 47.6 |
| Yes | 60.0 | 35.7 | 61.5 | 52.4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| | Mean score* | | | |
| If yes, success of arrangement is rated as | 3.8 | 4.2 | 4.1 | 4.0 |

Measured on a Likert scale of 1 (not at all) to 5 (very well)

The above findings are consistent with earlier studies on the supply of IT professional manpower and R&D scientists and engineers in Singapore in the late 1990s that reported a high degree of dependence on foreigners (Wong 2004). While the small domestic population is clearly a contributing factor, another reason is the need to tap people with international work experience or regional market exposure, due to the regional hub role of many of the surveyed firms.

In order to ensure a greater supply of innovators in Singapore, manpower needs to be trained and developed (cited by 37.8% of respondents, see **Table 4.4.6**). This takes a variety of forms, such as changing the education system to focus on creativity and problem solving, and having more international training, to increase the exposure of local talent. On a broader scale, firms see a need for Singapore to develop a culture of open-mindedness and creativity (17.8% of respondents). That is, a society which is less regulated and more tolerant of diversity.

**Table 4.4.6: Ways to ensure a greater supply of innovators in Singapore**

| | Percentage of respondents |
|---|---|
| HR development | 37.8 |
| Culture of open-mindedness and creativity | 17.8 |
| Development of market/industry | 15.6 |
| Attract/sensible use of foreign talent | 11.1 |
| Government support | 8.9 |
| Willingness to pay for resources | 6.7 |
| Other | 17.8 |
| Total | 100.0 |

*Note*: %'s do not add to 100% as multiple responses are included

Respondents also mentioned the need to develop the local market/industry. This included increasing market demand, reducing regulation and developing industrial clusters, as well as having more options to collaborate with academic institutions.

Virtually all companies (97.6%) acknowledge that managing innovators involves special challenges (**Table 4.4.7**). Firms need to establish structures within the organization to encourage innovation, and to cope with the challenges that innovators may pose to firm's existing processes. However, the most frequently mentioned challenge involves managing relationships with innovators – especially their relationships with non-innovators (26.8% of respondents). Tensions arise due to differing perceptions, outlooks and priorities, resulting in conflicts that may affect the efficacy of the firm. Respondents also mention the balance that must be maintained between innovativeness on the one hand, and being practical and consistent with company goals on the other. Innovators may develop ideas which are not practical to implement. Moreover, innovation in firms is not an end in itself, but ultimately a means of generating profit. All these issues point to the importance of communication between innovators and non-innovators, and the need for mutual understanding and an appreciation of each other's strengths.

**Table 4.4.7: Special challenges involved in managing innovators**

| | Percentage of respondents |
|---|---|
| No | 2.4 |
| Yes and special challenge is: | 97.6 |
| Managing relationships | 26.8 |
| Balance between innovativeness and company policy/practicality | 22.0 |
| Organizational issues | 17.1 |
| Need for flexibility | 7.3 |
| Need for innovation | 4.9 |
| Others | 14.6 |
| na | 4.9 |
| Total | 100.0 |

It is not surprising then that one of the most commonly cited organizational arrangements suggested to maximize the benefit from innovators is working in teams (about 30% of respondents, see **Table 4.4.8**). Such an arrangement allows the firm to balance the relative strengths and weaknesses of their human resources, e.g. innovators can be paired with executors. Firms also point to the need for flexibility, both as a mindset, and as a work arrangement (e.g. flextime) (26.7% of respondents), adopting a consultative and flat organizational structure(22.2%), as well as an incentive structure which rewards performance and incorporates accountability (20.0%).

**Table 4.4.8: Organizational arrangements to maximize benefit from innovators**

| | Percentage of respondents |
|---|---|
| Work in teams | 28.9 |
| Flexibility | 26.7 |
| Organizational structure and culture/Management | 22.2 |
| Rewarding performance/accountability | 20.0 |
| Empowerment | 8.9 |
| Increasing exposure | 6.7 |
| Resources | 6.7 |
| Independence | 4.4 |
| Variety | 2.2 |
| Technical leadership | 2.2 |

*Note*: %'s do not add to 100% as multiple responses are included

### 4.5 Singapore as an innovative city

Singapore's efficiency infrastructure is generally perceived to be better developed than its innovation infrastructure. 80% of respondents agreed that Singapore is an efficient city from a business point-of-view, whereas only 46.7% rated Singapore as having a high chance of becoming an innovative city within this decade (**Table 4.5.1**). Amongst those who disagree that Singapore is an efficient city, the most critical lack in the city's efficiency infrastructure is a sound regulatory framework.

Firms in the KIBS sector are the least optimistic about Singapore's efficiency and innovation infrastructure. Only 53.4% of KIBS firms agreed that Singapore is efficient, compared with over 90% of firms in the high-tech and creative content sectors. Moreover, 80% of the respondents who disagreed that Singapore is an efficient city were from the KIBS sector. Similarly, only one-third of KIBS firms give Singapore a high chance of becoming an innovative city within this decade, compared to 50%-60% of high-tech and media/creative firms.

**Table 4.5.1: Singapore as an efficient and innovative city (Percentage of respondents)**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Singapore is an efficient city from a business point of view | | | | |
| Strongly disagree | | 6.7 | | 2.2 |
| Disagree | | 20.0 | 7.1 | 8.9 |
| Neutral | 6.3 | 20.0 | | 8.9 |
| Agree | 50.0 | 46.7 | 50.0 | 48.9 |
| Strongly agree | 43.8 | 6.7 | 42.9 | 31.1 |
| Total | 100 | 100 | 100 | 100 |
| Singapore's chances of becoming an innovative city within this decade | | | | |
| Very low | | 6.7 | 7.1 | 4.4 |
| Low | 25.0 | 40.0 | 21.4 | 28.9 |
| Neutral | 18.8 | 20.0 | 21.4 | 20.0 |
| High | 37.5 | 20.0 | 50.0 | 35.6 |
| Very high | 18.8 | 13.3 | | 11.1 |
| Total | 100 | 100 | 100 | 100 |

One factor that may have contributed to the lower optimism of the KIBS sub-sector overall is the high presence of venture capital firms in the KIBS sample (6 out of 13 firms), which collectively gave lower rating to Singapore. As these firms use Singapore as a base to source for investment deal flows regionally and even globally, they found the supply of investible, innovative high-tech start-ups to be lower than in larger economies like Taiwan and China.

The most frequently reported factor that would help Singapore to become more innovative was openness[3]. Companies note the need for Singapore society as a whole to become more tolerant of diverse views and of failure, and a reduction of regulation. This extends to the business environment, such as deregulation of industry to ensure more level competition (particularly the media industry), and liberalizing laws regulating business (to allow for exit strategies for failed firms). It also extends to the education system, moving away from the focus on retention of facts and exam-based learning, toward encouraging creativity and problem-solving.

While the above findings need to be interpreted cautiously, given the subjective nature of the respondents' interpretation of the question, they do appear to be consistent with other international benchmark indicators that Singapore scores high on efficiency but only moderately in innovativeness (see e.g. recent World Competitiveness Reports and Global Competitiveness Report). Several of the respondents who were more pessimistic in their assessment of Singapore's chances to become innovative warned of a significant downside to Singapore's future economic development, given the strong competition emerging from China and India. Indeed, similar concerns have been articulated in the Report of the Economic Review Committee (ERC 2002), and provided the impetus for its recommendations for major policy change in the future.

On the whole, the respondents indicated that the innovation infrastructure in Singapore most needed at this time is the availability of innovators and global linkages, the latter being particularly emphasized by the KIBS firms. Research institutes are also needed particularly by firms in the high-tech sector. Competitive markets and IP legal framework were perceived to be the least important, particularly by KIBS firms, perhaps the existing situation is already quite adequate. (**Table 4.5.2**).

About 80% of companies perceive the need for specific investments to attract innovative people to Singapore, particularly in venture capital/funding and education/training (**Tables 4.5.3a** and **4.5.3b**). These two factors accounted for 41.7% of responses from those who see the need for investments. Firms in the high-tech sector also note the importance of developing a critical mass of R&D in Singapore, with R&D institutions, facilities and firms conducting R&D. There is also a need for creative services. This can be seen from two perspectives: to improve the quality of life in Singapore through investment in art galleries, theatres, etc; and to further the development of the media/creative sector through investment in human capital.

Those who do not see the need for investments to attract innovative people point out that Singapore does not need further expenditure on infrastructure, but rather less tangible developments, such as changes in culture and people's mindsets, and deregulation.

[3] Answered only by those who gave Singapore a low chance of becoming an innovative city in the next decade

**Table 4.5.2: Singapore's innovation infrastructure**

| | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| Availability of Innovators | 4.4 | 4.1 | 4.6 | 4.4 |
| Global Linkages | 3.9 | 4.3 | 4.0 | 4.0 |
| Venture Capital | 3.8 | 3.6 | 4.1 | 3.8 |
| Business Related Services | 3.9 | 3.5 | 3.7 | 3.7 |
| Research Institutes | 4.1 | 3.3 | 3.6 | 3.7 |
| Competitive Markets | 3.6 | 3.2 | 3.4 | 3.4 |
| IP Law Framework | 3.3 | 2.9 | 3.9 | 3.4 |

Measured on a Likert scale of 1(least needed) to 5 (most needed)

**Table 4.5.3a: Investments needed to attract and retain innovative people to Singapore**

| Are specific investments needed to attract and retain innovative people to Singapore? | High-tech | KIBS | Media/ creative | Overall |
|---|---|---|---|---|
| No | 6.3 | 35.7 | 14.3 | 18.2 |
| Yes | 87.5 | 64.3 | 85.7 | 79.5 |
| Yes and No | 6.3 | 0.0 | 0.0 | 2.3 |
| Total | 100 | 100 | 100 | 100 |

**Table 4.5.3b: Investments needed to attract and retain innovative people to Singapore**

| | Percentage of respondents |
|---|---|
| No | 18.2 |
| Yes | 79.5 |
| Yes and No | 2.3 |
| Type of investments? | |
| VC, funding | 18.2 |
| Education and training | 15.9 |
| Arts and creative products/services | 11.4 |
| R&D institutions & companies | 9.1 |
| Adequate compensation | 4.5 |
| na | 4.5 |
| Other | 18.2 |
| Total | 100.0 |

From the interviews with the respondent firms, it is highlighted that human capital development is not just important for attracting innovative people to Singapore, but also for the firms' continued business operations. Training and development is needed for the people at every level of the company, including innovators, investors, investees and management. The type of training specified also covers a

wide range, from cultural education and broadening of people's mindsets to specific skills such as customer service.

Some respondents also highlighted that investment is also needed in entrepreneurship. This includes access to venture capital and funding, particularly for SMEs which typically find it harder to obtain such support. One concern for SMEs is being crowded out by MNCs and GLCs, thus the need for large companies to be open to giving contracts to smaller companies. Another aspect highlighted is market development. Singapore's small size means that market development must include developing export markets, such as branding of Singapore goods and services.

Investment in innovation and product development is also needed, particularly for respondents in the high-tech sector, while creative content firms report the need for investment in creative products, content development and wireless infrastructure.

Finally, in order for firms to attract and retain foreign talent, several respondents indicated that Singapore's social infrastructure needs to be developed. Such investments will draw talent by improving the quality of life here, and include extending the range of leisure activities available.

### 4.6 Business services needed for innovation

R&D and design services (including product and industrial design) are among the most critical for firms' ability to innovate (cited by 30.8% of respondents, see **Table 4.6.1a**). This was followed by marketing, PR, advertising and communications services (24.4%). These reflect companies' twin concerns of improving their products through innovation, and simultaneously increasing the market demand for such products.

Other supporting services widely needed include legal and IP services, and industry and technology consulting services, both of which were cited by 7.7% of respondents.

From the perspective of the respondents, there appears to be much room for improvement for the availability and quality of most innovation-supporting services in Singapore (see **Table 4.6.1b**). Except for logistics and ICT services, which are already well-developed in Singapore, average ratings for the availability of services vary from between 2.3 to 3.0 on a scale of 1 (very easy) to 5 (very difficult). Similarly, their average ratings of their quality vary rated from 2.5 to 3.5 on a scale of 1 (very bad) to 5 (very good).

**Table 4.6.1a: Business services which are most critical for firms' ability to innovate**

| | Percentage of responses |
|---|---|
| R&D/design/ technology | 30.8 |
| Marketing/PR/communications | 24.4 |
| IP rights/legal | 7.7 |
| Consulting | 7.7 |
| Financial/ accounting/funding | 6.4 |
| Logistics | 6.4 |
| ICT | 5.1 |
| HR/mindsets | 3.8 |
| Education/RICs | 2.6 |
| Industry specific | 2.6 |
| Business innovation | 1.3 |
| Contract manufacturing | 1.3 |

*Note*: Includes multiple responses

**Table 4.6.1b: Business services which are most critical for firms' ability to innovate**

| | **Availability** | **Quality** |
|---|---|---|
| R&D/design/ technology | 2.8 | 3.4 |
| Marketing/PR/communications | 2.9 | 3.3 |
| IP rights/legal | 2.7 | 3.0 |
| Consulting | 2.8 | 2.8 |
| Financial/ accounting/funding | 2.8 | 3.0 |
| Logistics | 4.8 | 4.6 |
| ICT | 4.3 | 3.8 |
| HR/mindsets | 2.3 | 4.0* |
| Education/RICs | 3.0 | 3.5 |
| Industry specific | 2.5 | 2.5 |

Note: Availability rated on a scale of 1(very difficult) to 5 (very easy)
Quality rated on a scale of 1(very bad) to 5 (very good)

## 4.7 Summary of Differences Between Sectors

**Table 4.7** below summarizes the differences between the three innovation sectors along a number of key dimensions covered in this study. The asymptotic significance of the non-parametric Kruskal-Wallis H statistic is reported for each variable to show if the observed differences are statistically significant. From the summary table, several interesting observations can be made.

**Table 4.7 Key differences between the three innovative sectors**

| | High-tech | KIBS | Media/ creative | Asymptotic Significance of Kruskal-Wallis H test statistic |
|---|---|---|---|---|
| % of Firms that produce outputs covered by IP law | 100.0 | 60.0 | 92.9 | **.006**** |
| % of Firms seeking innovation that can be protected by IP law | 87.5 | 53.3 | 71.4 | .116 |
| For firms seeking innovation, Average % of revenue directed toward innovation[4] | 12.2 | 21.0 | 41.9 | **.048**** |
| % of Firms that faced Major Constraints to Seeking Innovations covered by IP Law | 81.2 | 26.7 | 64.3 | **.008**** |
| % of Firms that that feel that internal changes can help increase efforts to produce IP protected outputs | 62.5 | 40 | 57.1 | .437 |
| % of Firms that that feel that changes outside the firm can help increase efforts to produce IP protected outputs | 81.2 | 33.3 | 64.3 | **.025**** |
| % of Firms that believe effective IP Law Regime is Important in firm | 87.5 | 46.7 | 71.4 | **.051*** |
| % of Firms that believe effective IP Law Regime is Important in industry | 100.0 | 66.7 | 85.7 | **.040**** |
| % of Firms that feel that supply of innovators is a real issue for them | 90.6 | 78.6 | 92.9 | .267 |
| % of Firms that feel that there is particular skill or ability whose absence has prevented firm from being more innovative | 81.3 | 69.2 | 50.0 | .195 |
| % of Firms that tried to substitute for skills that are scarce in Singapore by using people located elsewhere | 60.0 | 35.7 | 61.5 | .318 |
| % of Firms that think Singapore is an efficient city from a business point of view[5] | 93.8 | 53.3 | 92.9 | **0.008**** |
| % of Firms that rate highly Singapore's chances of becoming an innovative city within this decade[6] | 56.3 | 33.3 | 50.0 | .430 |

* significant at 10% ** significant at 5%

Firstly, in analyzing the extent to which firms engage in innovations that are protected by IP laws, the KIBS sector appears to be lagging behind the other two sectors, especially the high-tech manufacturing sector. This is seen in the significantly lower proportions of KIBS firms that are currently producing IP protected outputs and that perceive effective IP laws as important to either their industry or their own firms.

[4] Significance of F statistic using ANOVA is .054, leading to a similar conclusion as when using the Kruskal Wallis test

[5] Significance of F statistic using ANOVA is .002, leading to the same conclusion as when using the Kruskal Wallis test

[6] Significance of F statistic using ANOVA is .370, leading to the same conclusion as when using the Kruskal Wallis test

At the same time, we also observe that KIBS firms face the least supply side constraints to innovating and producing outputs covered by IP laws. Compared to the other two sectors, the proportion of firms that experienced major constraints to innovating and desired external changes was significantly lower.

It is interesting to note that while the perceptions of Singapore's status as an efficient city did differ significantly between the sectors (with firms in the KIBS sector less likely than their high-tech manufacturing and creative content counterparts to rate Singapore as an efficient city from a business point of view), there was no significant difference in their rating of Singapore's chances to become an innovative city in the future.

In terms of the supply of skills in Singapore that enable innovation to take place, no statistically significant differences are found between the three sectors. Most firms from all the three sectors believed that supply of innovators is a real issue and that there are shortages of specific skills in Singapore that keep them from being more innovative. However, high-tech manufacturing firms and creative content firms appear to be more aggressive than KIBS firms in recruiting skills from overseas to fill the gap of skills availability in Singapore.

Last, but not least, the interviews with the respondents from the three innovative sectors have sensitized us to various nuanced differences between the technological innovators and the creative content producers, even though these are less easily captured in structured measures such as summarized in Table 4.7. For example, more than one interviewee pointed out that many creative contents tend to be more localized/culture-bound and less easily globalized compared to technological products, and hence such firms feel more hemmed in by the small domestic market of Singapore. The cultural fragmentation of Asian content markets add further to the constraints of operating in Singapore as a content hub. In contrast, high-tech innovators, while facing similar constraints of small domestic markets, see potential to go global, including penetrating the lead user markets of US and Europe, if their products are truly innovative and protected by strong IP. Technological innovators and creative content producers also differ in their perspective on government content regulation. While it is a non-issue for the former, a number of respondents in the latter group do express some concerns. The supporting services for technological innovators also appear different from those for creative content producers. Indeed, even the use of a common KIBS classification for innovation support services like IP-related law firms may be misleading, for the legal skills needed to support high-tech businesses may be quite different from those needed for creative content industries. As one interviewee correctly pointed out, the right IP strategies in "copyright" industries (music, movie, etc.) may be very different from those pursued in "patent" industries (high-tech manufacturing), as different business domain knowledge and legal specializations are needed.

## 5. Conclusion

Notwithstanding the explorative nature of this study, the preliminary findings derived from the survey of industry actors appear to largely confirm a number of earlier findings reported in the literature concerning Singapore's business environment for high-tech innovation and KIBS (see e.g. Wong 2004 and Wong and He 2004). The finding that Singapore is highly rated in terms of business efficiency but only moderately so in terms of innovation is also consistent with other international benchmarking indicators provided by sources such as the Global Competitiveness Report and the World Competitiveness Forum. Overall, the fact that the perception of Singapore's chance to become an innovative city is only moderately favorable underlies the awareness of growing regional competition, particularly from China and India. Indeed, the need to become more innovation–driven vs. investment-driven has been recognized by the Singapore government as a major strategic shift in the city-state's future economic development as outlined in the recent Report of the Economic Review Committee (ERC 2002). However, the drive for innovation does not appear to imply a lesser need for efficiency; indeed, many of the industry actors indicated that an efficient business infrastructure is a pre-requisite for their locating their innovative activities in Singapore, suggesting a complementary relationship rather than a substitutional relationship between innovation and efficiency. Still, a few respondents did voice a need for Singapore to allow for a bit more "chaos" and to be more tolerant of non-conformance behavior (Florida 2002) to foster more creativity.

While the importance of innovation and the need to translate it into protectable intellectual property (IP) appears to be widely recognized by industry actors in all three sectors covered in our study, interesting differences can be discerned. On the whole, development of IP and its effective protection appear to be of greater importance to the high-tech, R&D-intensive manufacturing sector and the creative contents sector than to the KIBS sector. Reflecting perhaps the more tacit or process know-how nature of the knowledge in use in many KIBS activities, which are less easily convertible to tangible IP assets, the KIBS sector exhibited lower concern with tangible IP protections than the high-tech manufacturing and creative contents sectors, even though its innovation intensity appears to be higher than the high-tech manufacturing sector. Another interesting difference is that while competition in high-tech innovation tends to be global, competition in creative contents tends to have a stronger local or regional dimension.

These and other salient contrasts found between the concerns of high-tech innovators, the creative content producers and the innovation-facilitating KIBS sector suggest that the three sectors may be driven by somewhat different dynamic forces even as they share some commonalities and mutually interact. In particular, what makes a city "innovative" in terms of development of globally competitive high-tech clusters may not necessarily be conducive to making the city "innovative" in terms of the development of

a globally attractive creative content industry. The underlying innovative talents, supporting services and possibly policy environments may differ in subtle ways. In particular, there appear to be some distinctive differences in the factors that are attractive to the "patent" industries (high-tech R&D) vs. the "copyright" industries, reflecting differences in the way science-based innovation works vs. artistic creation. In turn, these differences imply that the KIBS competencies needed for supporting "Silicon Valley"-style high-tech ventures are not the same as the KIBS skills needed to support Hollywood-style creative content businesses. On the other hand, there may also be emerging areas where technological innovation and creative contents truly merge, as in the multimedia gaming industry. Public policies to support the development of innovative capacities of cities thus needs to be fine tuned.

While Florida (2002)'s work has clarified some of the differences between the characteristics of the talents working in "patent industries" and "copyright industries," we believe that further research need to be done to examine the appropriate public policies toward these two industrial clusters in terms of the IP framework and labor development. Another issue concerns the potential for synergistic interaction between the two industrial clusters, especially where they are driven by new technological forces such as digital convergence and the emergence of new IP models such as Lessig's Creative Commons (creativecommons.org) and the Open Source movement.

In the context of East Asia, where there has been a longer history of public policy practice in support of the development of technological innovation capabilities in the manufacturing sector, there may thus be a greater need to sensitize public policy makers to the nuanced differences in policies needed to promote the new creative content industries (and associated supporting KIBS). For example, the dramatic success of the Korean entertainment industry (pop music, TV/films) in penetrating much of East Asia in the early 2000s has been almost in spite of, rather than due to, public "innovation" policies which had continued to focus on technological innovation. It was only after the successful export of Korean entertainment has become evident that the Korean government began to formulate a "cultural industry" promotion policy. As a relatively late-comer to creative content industries, Singapore would do well to learn from not only the creative content leaders from the advanced Western countries, but also the home-grown lessons of other East Asian late-comers.

**References**


Arnold, W. (2003) Singapore Goes for Biotechnology, *New York Times*, August 26, W1.

Biomed-Singapore (2003) (http://www.biomed-singapore.com/bms/gi_mc.jsp).

Economic Development Board (EDB). (1999). *Annual Report: Life Sciences*, http://www.sedb.com/edbcorp/an_1999_13.jsp

Economic Development Board (EDB). (various years). *Report on the Census of Industrial Production*. Singapore: EDB

Economic Development Board (EDB). (various years). *Report on the Census of Manufacturing Activities*. Singapore: EDB

Economic Review Committee (ERC). 2003. *Report of the Economic Review Committee: New Challenges, Fresh Goals - Towards a Dynamic Global City*. Singapore: Ministry of Trade and Industry. Downloaded from: http://www.mti.gov.sg/public/ERC/frm_ERC_Default.asp?sid=150

Economic Review Committee (ERC) Service Industries Subcommittee, Financial Services Working Group. (2002). *FSWG Unveils Strategies to Position Singapore as a Pre-eminent Financial Centre in Asia*. Press statement of the Financial Services Working Group. Singapore: ERC. Downloaded from: http://www.mti.gov.sg/public/ERC/frm_ERC_Default.asp?sid=127

Economic Review Committee (ERC) Service Industries Subcommittee, Financial Services Working Group. (2002). *Positioning Singapore as a Pre-eminent Financial Centre in Asia*: *Executive Summary*. Singapore: ERC. Downloaded from: http://www.mti.gov.sg/public/PDF/CMT/ERC_SVS_FIN_ExecSum.pdf?sid=127&cid=1279

Economic Review Committee (ERC) Service Industries Subcommittee, Working Group (Legal Services). (2002). *Executive Summary of Report of the Working Group (Legal Services)*. Singapore: ERC. Downloaded from: http://www.mti.gov.sg/public/ERC/frm_ERC_Default.asp?sid=126

Economic Review Committee (ERC) Service Industries Subcommittee Workgroup on Creative Industries. (2002). *Creative Industries Development Strategy*. Singapore: ERC.

Economic Review Committee (ERC) Sub-committee on Entrepreneurship and Internationalisation. (2002). *Report of the Entrepreneurship and Internationalisation Sub-committee*. Singapore: ERC.

Finegold, D., Wong, P.K. and Cheah, T.C. (2004). "Adapting a foreign-direct investment strategy to the knowledge economy: The case of Singapore's emerging biotechnology cluster", *European Planning Studies* Vol. 12, No. 7, Oct 2004, p. 921-941

Florida, R. (2002), *The Rise of the Creative Class*, New York: Basic Books

Howkins, J. (2001), *The Creative Economy*. London: Penguin Press.

Muller, E. and A. Zenker(2001), "Business Services as Actors of Knowledge Transformation: The role of KIBS in regional and national innovation systems", *Research Policy* 30: 1501-1516.

Rosenberg, D. (2002). *Cloning Silicon Valley: The Next Generation High-Tech Hotspots*. London: Reuters

Saywell, T. (2001) Medicine for the Economy. *Far Eastern Economic Review*. Nov 15.

Schein, E. (1996). *Strategic Pragmatism: The Culture of the Economic Development Board of Singapore*. Cambridge, Mass: MIT Press.

Singapore Department of Statistics (DOS). (various years). *Economic Surveys Series: Business Services and Real Estate*. Singapore: DOS.

Singapore Department of Statistics (DOS). (various years) *Economic Surveys Series: Community, Social & Personal Services.* Singapore: DOS.

Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: Architectural, Engineering & Technical Services.* Singapore: DOS.

Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: IT & Related Services.* Singapore: DOS.

Singapore Department of Statistics (DOS). (2001). *Economic Surveys Series 2001: Professional Services.* Singapore: DOS.

Toh, M.H., Choo, A., Ho, T. (2003). "Economic contributions of Singapore's creative industries", *Economic Survey of Singapore First Quarter 2003*. Singapore: Ministry of Trade and Industry.

Wong, P.K. (1998), "Leveraging the Global Information Revolution for Economic Development: Singapore's Evolving Information Industry Strategy", *Information Systems Research*, 9(4),1998: 323-341

Wong, P.K. (2000). "Globalization of Electronics Production Networks and the Emerging Roles and Strategies of Singapore Contract Manufacturers", Proceedings of the *19th Annual Hosei University International Conference on Japanese Foreign Direct Investment and Structural Change in the East Asian Industrial System*, Tokyo, Oct. 30-Nov. 1.

Wong, P.K. (2001). "Singapore: Electronics and shipbuilding/repair industry case studies". In P.K. Wong and C.Y. Ng (eds.) *Industrial Policy, Innovation and Economic Growth: The Experience of Japan and the Asian NIEs*, p. 580-626. Singapore: Singapore University Press.

Wong, P.K. (2002), "Globalization of American, European and Japanese Production Networks and The Growth of Singapore's Electronics Industry", *International Journal of Technology Management* Vol. 24 No. 7/8: 843-869 (2002)

Wong, P.K.(2003), "From Using to Creating Technology: The Evolution of Singapore's National Innovation System and the Changing Role of Public Policy", in S. Lall and S. Urata(eds.), *Competitiveness, FDI and Technological Activity in East Asia*, London: Elgar

Wong, P.K. (2004a), "The re-making of Singapore's high tech enterprise ecosystem", forthcoming in W. Miller, H. Rowen and M. Hancock(eds), *Asia's High Tech Regions*

Wong, P.K., Kiese, M., Singh, A. and Wong, F. (2003). "The pattern of innovation in Singapore's manufacturing sector", *Singapore Management Review*, 25(1): 1-34

Wong, P.K. and Ho, Y.P. (2003). *Comparative Analysis of the Pattern and Composition of IP Creation in Singapore vs. Selected Advanced OECD Nations and NIEs*. Singapore: NUS Entrepreneurship Centre Research Report (submitted to the Ministry of Law)

Wong, P.K., and A. Singh (2004). "The pattern of innovation in the knowledge-intensive services sector of Singapore", *Singapore Management Review*, 26(1)

Wong, P.K. and Z.L. He (2004), "A comparative study of innovation behaviour in Singapore's KIBS and Manufacturing Firms", *Service Industries Journal*, Vol. 25, No. 2

Yeo G. (2002). *Press Conference to Release the Recommendations of the Economic Review Committee Sub-Committee on Manufacturing*, 18 October 2002, downloaded from http://www.mti.gov.sg/public/ERC/frm_ERC_Default.asp?sid=137&cid=1351

Yusuf, S. and S. J. Evenett. (2002), *Can East Asia Compete? Innovation for Global Markets*. New York: Oxford University Press.

Yusuf, S., et. al.(2003), *Innovative East Asia: The Future of Growth*. New York: Oxford University Press.

**ANNEX A** ***Policy initiatives for the high-tech sector proposed by the Economic Review Committee (ERC 2002)***

In the Economic Review Committee's 2002 report, the Singapore government signalled its intention to continue leveraging on manufacturing as a source of growth for the economy. The electronics and biomedical industries were two of the five clusters highlighted for further development.

With costs of production rising in locally and countries such as China and India becoming more popular locations for manufacturing, Singapore must move away from doing mere production to creating innovative products and business. In doing this however, Singapore will face competition from the developed countries with their advanced innovations and technologies.

Thus the initiatives and strategies put forward by the ERC are broad-ranging, including developing activities on the high value-added end of each industry, as well as manpower, research facilities, international collaboration, market access, IPR and funding:

Electronics industry

- Develop new capabilities in semiconductor equipment, chemicals and materials, industrial design as well as R&D in new technologies including photonics and nanotechnologies
- Centralise cogeneration facilities for wafer-fab parks that could generate 25% cost savings per participant
- Improve semiconductor-manufacturing infrastructure through development of shared facilities including training
- Enhance benefits of twinning with Riau Islands by improving logistical links and supporting industries
- Grow new industries in photonics, display, network storage and wireless products that benefit from existing 'clean room' capabilities
- Develop New Supply Chain Models including 'forward hubbing/floating warehouse' facilities
- Establish specialised funds for wireless IC and fables IC design

Biomedical industry

- Develop a 'Plug & Play' environment for both manufacturing and R&D, including the support services that span the whole industry
- Continue to expand and train biomedical sciences manpower pool, through various approaches including A*STAR's National Science Scholarships, EDB's manpower training schemes as well as the industry-led Biomedical Manpower Advisory Committee (BMAC)

- Focus on higher value-added manufacturing and new/advanced manufacturing technologies
- Build up public research capabilities to support manufacturing activities, e.g. Bioprocessing Manufacturing Technology Centre (BMTC), Institute of Chemical Sciences (ICS)
- Promote industry to move towards upstream activities that will help anchor future manufacturing activities through facilitating collaborations with centres of excellence/'Luminary Centres' in our hospitals, the universities and A*STAR's research institutes.
- Expand market access through improving the regulatory envioronment and increasing recognition by foreign regulatory authorities
- Enhance marketing & communications strategy to profile biomedical science manufacturing
- Continue to nurture local venture capitalists (VCs), incubators and startups

In order to fulfil these initiatives, the Government will continue many of its current strategies, such as encouraging MNCs to locate in Singapore to take advantage of their technology, management know-how and markets. Other strategies include maintaining cost competitiveness, and providing an attractive business environment for value-added manufacturing, by facilitating adoption of new technologies and development of new markets. Singapore aims to establish itself as a regional hub, which companies use as a base for their high value-added manufacturing activities.

Developing and acquiring the necessary human resources is central to accomplishing these objectives. The dual strategy of continued investment in education - particularly in science, mathematics and IT - while simultaneously encouraging foreign talent to locate in Singapore is used. The recent push to develop local arts and culture is part of this strategy, a bid to make Singapore a more attractive location for foreign manpower and companies.

In order to attract more foreign manufacturing to Singapore, local R&D activities must be further developed. This will involve establishing infrastructure, training the necessary manpower and attracting foreign researchers. It will also involve encouraging public and private organisations to co-operate with MNCs in R&D. The Biomedical Research Council (BMRC) and Science and Engineering Research Council (SERC), under A*STAR will oversee the development of the public R&D infrastructure. Research institutes have been established to support industry clusters and foreign scientists have been brought in to enhance local research capabilities. The government has also instituted incentive schemes to encourage R&D activities.

Recognizing the importance of developing linkages within the innovation system, the ERC highlighted that developing Singapore's innovation capabilities involves strengthen links between R&D, IP development and industry. Public research institutes are encouraged to spin off high-tech companies and are given the task of developing R&D manpower for industry.

Given Singapore's small size, developing export markets is a serious concern for industry. The Singapore government works towards securing market access to other countries through multilateral and pursuing a wise range of bilateral trade agreements.

Funding schemes to encourage innovation recommended by the ERC include tax incentives, incentives for companies to become test beds for new technologies, grants for acquisition and training, and continuing venture capital schemes such as SEEDS (Startup Enterprise Development Scheme).

Protection of innovation requires the development of the IP and legal cluster. (See KIBS section for more details on policy initiatives in this area).

## ANNEX B *Policy initiatives in the KIBS sector proposed by the Economic Review Committee (ERC 2002)*

The ERC report also identified the services sector as source of growth for the Singapore economy. Its development will build on the city's existing strengths of a well-educated workforce, good physical infrastructure, strategic geographical location, and a conducive legal environment.

Priority will be given to certain KIBS industries covered by our study, including ICT, financial services and IP/legal services.

One main emphasis in the ERC report in on the transformation of Singapore into a regional and international services hub, which again arises from the city's reliance on external markets. Hence one key recommendation is to increase export demand for these services by marketing Singapore's services industries more aggressively, and by simplifying procedures and regulations to make it convenient for overseas consumers to come to Singapore to make use of its services. In order to stimulate local demand, recommendations include the Government outsourcing activities (e.g. fund management and IT solutions) as well as catalyzing experimental and cutting edge projects (e.g. by leading ICT pilots and trials),

The development of manpower is a key aspect. KIBS industries are, if anything, more talent-dependent than manufacturing. Although Singapore will maintain its current emphasis on technical and engineering education, the need for talent in the service industries prompted the ERC to recommend a review of manpower training for service industry (including services training at the tertiary level).

ERC recommendations for the legal sector include:

- Changes in legal education – including developing expertise in nice areas such as life and bio-sciences, information technology and media, e-commerce, cyberlaw and various aspects of international trade law and financial services, and Chinese laws.
- Establishing research institutes, international collaborations and other facilities that will promote Singaore as a regional hub for legal training and research
- Regularly reviewing the quota for admissions into the Law faculty so that the quota of lawyers can be adjusted according to market needs
- Periodical review of qualifying standards for overseas law graduates to be admitted into the Singapore bar
- Formation of multi-disciplinary partnerships for legal work or business outside Singapore
- Promote effective regionalisation of Singapore law firms and lawyers, including promoting and marketing of legal services
- Promote Singapore as a Regional Alternative Dispute Resolution ("ADR") Service Centre

- Provide fiscal incentives to promote the location of in-house legal departments and personnel in Singapore, so that Singapore lawyers can provide services to MNCs
- Promotion of Singapore as a regional intellectual property hub – including development of encourage the development of skills for IP and legal documentations, setting up an IP Academy (which was accomplished in January 2003), and providing incentives for IP creation and exploitation. Positioning Singapore as an IP management centre will allow it to attract royalties from Singapore registered patent holdings.

The ERC's recommendations for establishing Singapore as a financial centre in Asia are:

- Accelerating efforts to increase the depth and breadth of the wealth management industry in Singapore
- Positioning Singapore as a global processing centre
- Developing Singapore into the leading risk management centre in the Asia Pacific
- Creating a world-class business environment that encourages firms in Singapore to capitalize on emerging opportunities in financial services

**ANNEX C** ***Policy initiatives in the creative content sector proposed by the Economic Review Committee (ERC 2002)***

The Economic Review Committee defined the creative industries as follows:

- Arts and culture: performing arts, visual arts, literary arts, photography, crafts, libraries, museums, galleries, archives, auctions, impresarios, heritage sites, performing arts sites, festivals and arts supporting enterprises
- Design: advertising, architecture, web and software, graphics, industrial product, fashion, communications, interior and environmental
- Media: broadcast (including radio, television and cable), digital media (including software and computer services), film and video, recorded music and publishing

These creative industries have also been targeted as a priority area in the development of Singapore's service sector. Some of the broad strategies that will be adopted for the KIBS industries (e.g. marketing of local content and training/development of manpower) will also apply to the creative industries. However, one difference between the two sectors is that the creative industries have a public welfare dimension. As such, the ERC recommended establishing a Ministerial Committee on Services to manage the tension between economic and social objectives of policies.

The ERC set two specific targets for the creative cluster by 2012: to increase it contribution to GDP to 6%; and to establish a reputation for Singapore as a New Asia Creative Hub. In order to achieve this, it has developed three key programs, known as Renaissance City 2.0, Design Singapore and Media 21.

Renaissance City 2.0 aims to develop Singapore into an innovative and multi-talented global city for arts and culture. There are three main strategies subsumed under Renaissance City 2.0:

1 Build creative capabilities

- Embed arts, design and media within all levels of education, e.g. using drama and literature to help students enhance their language abilities and multimedia tools to allow students to approach science and maths projects in an innovative manner
- Establish a flagship art, design and media university program in collaboration with leading international institutions. This new School of Art, Design and Media could differentiate itself by offering a broad-based and research-oriented curriculum

.

2 Stimulate sophisticated demand

- Establish a "Percent-for-the-Arts" scheme which will promote public art by including artworks in public spaces
- Develop fusion library space for the people
- Work with Community Development Councils to develop "Creative Towns". Creative Towns would integrate arts, culture, design, business and technology into community planning and revitalization efforts. Features of a Creative Town could include the "Percent-for-the-Art" Scheme, fusion spaces, entrepreneurship training programs, creative thinking courses, cultural events and festivals, etc
- Develop a virtual cultural resource network
- Transform Singapore Art Series into Singapore Biennale to enhance Singapore's international profile
- Develop a new Museum of Modern and Contemporary Art to strengthen Singapore's standing as a global city for arts and culture

3 Develop creative industries

- Promote arts and cultural entrepreneurship
  - MITA agencies to work with Singapore Tourism Board to develop cultural tourism
  - National Arts Council to develop arts and design industries
  - National Heritage Board to exploit Singapore's wealth of heritage resources to go into merchandising and arts and heritage consultancy
  - National Library Board to venture into global knowledge concierge service, develop the information services sector and provide library consultancy services

Design Singapore aims to develop Singapore into a global cultural and business hub for the design of products, content and services. It comprises four strategies:

1 Integrate design in enterprise

- Identify and develop iconic Singapore products and services
- Promote design in the public sector
- Raise business awareness of design excellence
- Facilitate use of design by businesses

2 Develop a vibrant & professional design community

- Establish a flagship university program in art, media and design
- Enhance design education in secondary schools, polytechnics & arts schools
- Establish design testbeds
- Enhance professional standing of designers

3 Position Singapore as a global design hub

- Establish a National Design Council with representation from industry, the design community, education institutions and the public sector. Such an agency would then be positioned to forge links as the one-stop contact for design locally and internationally, nurture the local design industry, and advocate design excellence in Singapore
- Anchor international design companies and activities in Singapore
- A national marketing and branding strategy

4 Foster a design culture & awareness

- Embed design in all levels of education
- Bring design everywhere
- Design in the mass media

Media 21 aims to establish Singapore as a global media city. It has five key strategies:

1 Develop a media city in Singapore

- Develop Mediapolis @ One North. Mediapolis will cluster high value-adding media production and R&D activities in a conducive "work, live, play and learn" environment that supports experimentation and multidisciplinary cross-pollination
- Enhance applied research in digital media
- Specialize in digital post-production
- Expedite national deployment of digital media services

2 Position Singapore as a media exchange. Developing a financing and trading exchange hub for media in Singapore will allow for the creation, acquisition and exploitation of media copyrights, as well as producing economic spinoffs

- Introduce tax incentives to attract media investments
- Establish a loan fund for copyrighted media materials

- Attract media finance companies and VCs
- Create and manage a registry of media copyrights
- Grow media markets @ Singapore

3 Export Made-by-Singapore content

- Establish a content development fund
- Develop niche genres
- Increase bilateral co-production agreements
- Increase exports promotion

4 Augment the media talent pool

- Establish a media academy
- Enhance specialist skills
- Create opportunities for exposure to world's best
- Embed media training into school curricula
- Enhance knowledge of intellectual property rights

5 Foster a conducive regulatory environment and culture

- Ensure policies and procedures meet international best practices
- Ensure regulatory consistency and clarity
- Facilitate a production-friendly environment
- Encourage industry responsibility and responsiveness
- Increase public education and empowerment

**Annex Table 1 List of respondents**

| No. | Company Name | Sector | Industry | Sub-industry | Year established in Singapore |
|---|---|---|---|---|---|
| 1 | Bernard Technologies Asia Pacific | High-tech | Life Sciences/ Biomedical | Anti-microbial products | 1997 |
| 2 | Biolitec | High-tech | Life Sciences/ Biomedical | Medical Lasers/ Pharmaceuticals | 2002 |
| 3 | CordLife Pte Ltd | High-tech | Life Sciences/ Biomedical | Stem Cell Science | 2001 |
| 4 | Danisco Animal Nutrition | High-tech | Life Sciences/ Biomedical | Animal Nutrition | 1993 |
| 5 | KOOPrime Pte Ltd | High-tech | Life Sciences/ Biomedical | Bioinformatics | 2000 |
| 6 | Eastgate | High-tech | Electronics/ IT Manufacturing | Optical Storage Media | 1989 |
| 7 | Ellipsiz | High-tech | Electronics/ IT Manufacturing | Semiconductor/ Wafer Fabrication | 1992 |
| 8 | InfoWave Pte Ltd | High-tech | Electronics/ IT Manufacturing | Telematics | 2002 |
| 9 | iWOW Technology | High-tech | Electronics/ IT Manufacturing | Wireless products | 2000 |
| 10 | Motorola Electronics | High-tech | Electronics/ IT Manufacturing | Telecommunication Products | 1973 |
| 11 | NEC Solutions Asia Pacific Pte Ltd | High-tech | Electronics/ IT Manufacturing | ICT | 1977 |
| 12 | Nera Telecoms | High-tech | Electronics/ IT Manufacturing | Microwaves and Satellites | 1989 |
| 13 | Pentex-Schweizer Circuit s Ltd | High-tech | Electronics/ IT Manufacturing | Printed Circuit Boards | 1977 |
| 14 | Savi Technology Asia | High-tech | Electronics/ IT Manufacturing | Wireless products | 2001 |
| 15 | Hewlett-Packard | High-tech | Electronics/ IT Manufacturing | IT products and services | 1972 |
| 16 | Allegro EMS | High-tech | Electronics/ IT Manufacturing | Semiconductor equipment contract manufacturing services | 2000 |
| 17 | AsiaQuest Ventures | KIBS | Consultancy Services | Business Development Consulting | 2002 |
| 18 | Greater China Consult Pte Ltd | KIBS | Consultancy Services | Business Development Consulting | 2000 |
| 19 | Perdana Consultants | KIBS | Consultancy Services | Engineering Consulting Services | 1983 |
| 20 | Lightspeed | KIBS | IT Services | IT Services (Remote systems) | 1988 |
| 21 | NCS Pte Ltd | KIBS | IT Services | IT Services (Software) | 1997 |
| 22 | Intelleigen | KIBS | Legal/ IP Services | Legal Services | 2002 |
| 23 | Rodyk & Davidson | KIBS | Legal/ IP Services | IP Services | 1861 |
| 24 | 3i in Asia Pacific plc | KIBS | VC / Fund Management/ Financial | Venture Capital | 1997 |
| 25 | iGlobe Partners | KIBS | VC / Fund Management/ Financial | Venture Capital | 1999 |

| No. | Company Name | Sector | Industry | Sub-industry | Year established in Singapore |
|---|---|---|---|---|---|
| 26 | Parallax Capital Management | KIBS | VC / Fund Management/ Financial | Alternative Investment | 1999 |
| 27 | Sirius Venture Consulting Pte Ltd | KIBS | VC / Fund Management/ Financial | Venture Consulting | 2002 |
| 28 | UOB Venture Management | KIBS | VC / Fund Management/ Financial | Venture Capital | 1992 |
| 29 | Walden International (S) Pte Ltd | KIBS | VC / Fund Management/ Financial | Venture Capital Fund Management | 1988 |
| 30 | Suntec City Singapore | KIBS | Other Services | Exhibition & Convention Services | 1985 |
| 31 | Ong & Ong Architects Pte Ltd | KIBS | Other Services | Design Consultancy Services | 1972 |
| 32 | Computer Times | Media/creative | Print Publishing | Technology Periodicals | 1993 |
| 33 | The Edge Asia Media Group | Media/creative | Print Publishing | News Periodicals | 2003 |
| 34 | Knowledge Village Pte Ltd | Media/creative | Software (including multimedia and games) | Educational Software | 1997 |
| 35 | Light and Shadow | Media/creative | Software (including multimedia and games) | Computer Animation | 1995 |
| 36 | Orange Gum | Media/creative | Software (including multimedia and games) | Content for Mobile Phones | 2000 |
| 37 | Perceptivei | Media/creative | Software (including multimedia and games) | Business Intelligence and CRM Software | 2000 |
| 38 | System Access Pte Ltd | Media/creative | Software (including multimedia and games) | Banking Software | 1983 |
| 39 | Valens CGV Pte Ltd | Media/creative | Software (including multimedia and games) | Computer Graphics and Games | 2002 |
| 40 | David Aslan Consulting | Media/creative | Software (including multimedia and games) | Mobile Applications | 2000 |
| 41 | Portal Studios | Media/creative | Software (including multimedia and games) | Entertainment/games | 2001 |
| 42 | Star Waves.TV Pte Ltd | Media/creative | Software (including multimedia and games) | Edutainment | 2001 |
| 43 | Drama Box | Media/creative | Others (Film, Drama production) | Drama Production & Performance | 1995 |
| 44 | Infinite Frameworks Pte Limited | Media/creative | Others (Film, Drama production) | Broadcast Post-Production | 1997 |
| 45 | Raintree Pictures | Media/creative | Others (Film, Drama production) | Film Production | 1998 |